COMPETITION, MARKET STRUCTURE, AND INCENTIVES IN THE HEALTH CARE INDUSTRY

By

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This dissertation is dedicated to my parents

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Abstract of Dissertation Presented to the Graduate School
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The first paper in this dissertation analyzes the incentives for cost reduction that different payment policies provide to profit-maximizing health care providers Ching-to Albert Ma ("Health Care Payment Systems Cost and Quality Incentives " *Journal of Economics and Management Strategy* 3 (1), 1994 93-112) proposes a reimbursement mechanism that seeks to induce the ideal level of cost reduction by using a combination of cost reimbursement and prospective payment in a model where higher effort on the part of the health care provider reduces treatment costs This paper shows that a health care provider facing a mechanism of this type generally will not provide the ideal level of cost reduction. However such a mechanism is optimal when the payer has both efficiency and distributional concerns.

The second paper models competition between health maintenance organizations (HMOs) and between indemnity providers of health care. When indemnity insurers have to rely on independent hospitals' reports of patient needs, they do not provide enrollees with full insurance. Instead, they employ copayments to ration the quality of treatment that patients obtain. HMOs that do not allow their enrollees freedom of provider choice can better enforce desired quality levels without having to resort to copayments. HMOs insure risk-averse consumers fully. HMOs may also provide higher quality treatment to their patients than do hospitals serving patients with indemnity insurance.

The third paper uses data from Florida hospitals to analyze the impact that competition and managed care have on hospital prices. I find that overall hospital prices increase as markets become more competitive. However prices at hospitals that draw a large fraction of their patients from managed care organizations either decrease or are not significantly affected as markets become more competitive. Prices at for-profit hospitals decrease while those at nonprofit hospitals increase with competition. The final chapter concludes the dissertation.

INTRODUCTION

The health care industry is currently undergoing rapid and dramatic changes. The debate among policymakers about the implications of these changes is often based on contradictory anecdotal evidence, so there is a pressing need for rigorous analyses of the problems facing the health care industry. The research in this dissertation examines the impacts of recent changes in the health care industry using rigorous empirical and theoretical methods of economic analysis.

The health care industry is characterized by informational difficulties that make the task of designing policies to promote efficient utilization of resources extremely difficult. In contrast to markets for most goods and services, purchasing decisions in heath care are typically not made by the final consumer. The private interests of the parties involved in treatment decisions can often lead to inefficient use of resources. For example, well-insured patients do not bear the full cost of treatment and so have an incentive to demand health care services to the extent that their benefits are far outweighed by their costs. Similarly, physicians and other health care providers have an incentive to over prescribe if their profits depend on the quantity of health care services consumed. Insurers have an incentive to seek out healthy subscribers and to avoid those with chronic or serious illnesses. The policymaker typically does not have the information required to enforce efficient decisions. The purpose of this research is to improve our understanding of the health care industry so that resources devoted to health care can be put to more efficient use

This dissertation consists of three papers The first paper examines the cost reduction incentives health care providers face under different reimbursement regimes The second paper examines the insurance contracts and treatment that patients will obtain under different systems of health care delivery The third paper provides an empirical analysis of the pricing behavior of hospitals and the impact competition and managed care have on hospital prices.

The first paper is entitled "Health Care Payment Systems Cost and Quality Incentives--Comment." It analyzes the incentives for cost reduction that different payment policies provide to profit maximizing health care providers Ma (1994) proposes a reimbursement mechanism that seeks to induce the ideal level of cost reduction by using a combination of cost reimbursement and prospective payment in a model where higher effort on the part of the health care provider reduces treatment costs. This paper shows that a health care provider facing a mechanism of this type generally will not internalize the full benefit of lower treatment costs and will not provide the ideal level of cost reduction. However I find that such a mechanism helps limit provider profit and is optimal when the payer has both efficiency and distributional concerns

The second paper "Competition and Market Structure in the Health Care Industry" models competition between HMOs and between indemnity providers of health care to analyze the insurance contracts and treatment that patients will obtain under different systems of health care delivery When indemnity insurers have to rely on independent hospitals reports of patient needs they do not provide enrollees with full insurance Instead they employ copayments to ration the quality of treatment that patients obtain. Hospitals that serve indemnity patients compete aggressively for well-insured patients In equilibrium patients receive inefficiently high treatment quality HMOs that do not allow their enrollees freedom of provider choice can better enforce desired quality levels without having to resort to copayments HMOs allocate risk efficiently so that risk averse consumers are fully insured HMOs may also provide higher quality treatment to their patients than do hospitals who serve patients with indemnity insurance

The third paper "Competition Managed Care and Hospital Pricing " uses data from acute care hospitals in Florida to analyze the pricing behavior of hospitals, and the impact that competition and managed care have on hospital prices This paper extends Dranove s (1988) model to examine how for profit and nonprofit hospitals' pricing behavior will change as competition increases. I find that overall hospital prices increase when hospital markets become more competitive However, prices at hospitals that draw a large fraction of their patients from managed care organizations (HMOs and PPOs) either decrease or are not significantly affected when their markets are more competitive Prices at for profit hospitals decrease while those at nonprofit hospitals increase with competition

Jointly the three papers in this dissertation address important aspects of the ongoing policy debate on the evolution of the health care industry It is my hope that some of the insights stemming from my research will be helpful in designing policies that enable greater benefits to be derived from the resources devoted to health care

HEALTH CARE PAYMENT SYSTEMS
COST AND QUALITY INCENTIVES--COMMENT

Introduction

Because the portion of national income spent on health care is large and increasing, cost containment in the health care industry is a major policy concern Therefore works such as Ma (1994) constitute important research In an elegant model, Ma analyzes the impacts of cost reimbursement and prospective payment plans on incentives for cost containment in the health care industry Under a cost reimbursement plan, the hospital (or other health care provider) is typically reimbursed for all the treatment costs it incurs Under a prospective payment plan, the hospital receives a fixed fee that varies with the patient's diagnosed illness. Ma demonstrates how prospective payment plans provide ideal incentives to limit treatment costs on patients who are treated, but may provide incentives for the hospital to refuse to treat (that is, to "dump") patients with high treatment costs Ma's research suggests that cost reimbursement can be used to limit these latter incentives

Ma also suggests that a mixed payment system that combines elements of cost reimbursement and prospective payment can provide ideal cost reduction incentives even when the provider can refuse to treat high cost patients The mixed payment system pays a fixed sum for patients whose treatment costs fall below a specified threshold and reimburses all costs when their treatment costs exceed that threshold[1] Unfortunately, this conclusion is true only in very special circumstances

The primary purpose of this note is to explain why mixed payment systems cannot, in general, both provide ideal incentives for cost reduction and prevent the dumping of high cost patients Essentially under mixed payment systems the hospital has less than ideal incentives to contain costs because it is unable to capture the full benefits of reducing the costs of serving patients who are paid for by cost reimbursement Thus mixed payment systems are not always a panacea Indeed I show that when a payer is concerned only with efficiency issues and so values patient welfare and hospital profit identically (as in Ma s analysis) she will prefer a (pure) prospective payment system to a mixed system I also show however that when the payer has distributional concerns and so values patient welfare more highly than hospital profit, she will prefer the mixed payment system identified by Ma to both a prospective payment system and a cost reimbursement system

My analysis proceeds as follows In the second section I briefly review the key elements of Ma s model I also show that a mixed payment system is generally not optimal in this setting. Next, I show how distributional concerns can render a mixed payment system the optimal system The final section concludes the note

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[1] Other authors have used the term "mixed systems" to denote payment systems that pay a fraction of realized treatment costs in addition to a fixed fee that is independent of the patient s treatment costs See for example Ellis and McGuire (1986) For an overview of the literature on the incentive effects of health care payment systems, see Newhouse (1996)

Payment Mechanisms and Ideal Cost Reduction

Consider a situation where a single payer, such as a private insurance company or a public program like Medicare, contracts with a profit maximizing hospital to provide treatment to patients.[2] For simplicity, all patients are viewed as identical by the payer. (For instance, all patients may have illnesses in the same Diagnosis Related Group (DRG).)[3] However, patients will ultimately differ in their cost of treatment. The realized cost of treating a patient is denoted $c \in [c^L, c^H]$.

The hospital can exert effort, e, to reduce realized treatment costs. The realized cost of treating a patient is distributed according to the probability density function $f(c;e)$, with the cumulative distribution function denoted $F(c;e)$. Let $C(e)$ denote the total cost of treating all patients when the hospital exerts effort e. That is

$$C(e) = \int_{c^L}^{c^H} cf(c;e)dc \tag{1}$$

Higher cost-reduction effort reduces total costs, so $C'(e) < 0$. The marginal benefit of effort decreases as more effort is provided, so $C''(e) > 0$.[4] The disutility incurred by the hospital from exerting cost-reduction effort is $\psi(e)$.

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[2] Although the health care provider is referred to as the hospital throughout the paper, the analysis applies equally to any other health care provider.

[3] Medicare has defined over 470 diagnosis related groups that require similar resource use in hospitals. The hospital is paid a fixed fee for each patient admitted under a DRG.

[4] To guarantee an interior solution, it is assumed that $C'(0) = -\infty$ and $C'(\infty)$ 0.

Disutility increases at an increasing rate with the amount of effort expended so $\psi'(e) > 0$ and $\psi''(e) > 0$

The hospital's realized costs of treating individual patients can be observed perfectly and costlessly by all relevant parties. Only the hospital observes the amount of cost reduction effort that it exerts. The functional form of $f(c,e)$ and $F(c,e)$ is common knowledge, as is the way in which effort affects realized costs.

The timing of the model is as follows. First the payer specifies the payment mechanism she will employ to compensate the hospital for treating patients. The hospital then chooses the amount of cost-reducing effort it will provide. Treatment costs are then realized, and the hospital treats those patients it finds profitable to treat. Finally, payments are made as promised.

A mechanism that induces the hospital to minimize the sum of production and effort costs will be referred to as a first-best mechanism. Formally, a first-best mechanism induces the hospital to choose e^* such that

$$-\int_{\underline{c}}^{\bar{c}} c f_e(c, e^*) dc = \psi'(e^*) \tag{2}$$

Ma (1994) shows that when the hospital cannot dump patients with high realized treatment costs, prospective payment causes the hospital to internalize treatment costs and induces the first-best level of cost-reduction effort, e^*. Cost reimbursement, in contrast, provides no incentives for cost reduction.

When the hospital can dump patients with impunity, however, a purely prospective payment system no longer induces effort e^* if the payment, p, is set below c^H. The hospital incurs a loss on patients whose costs exceed p and so refuses to treat them. The hospital now chooses e such that

$$\int_{\underline{c}}^{p}(p-c)f_e(c;e)dc = \psi'(e) \tag{3}$$

Lemma 1 The amount of effort exerted by the hospital will generally differ from e^* under a prospective payment system when it can dump high-cost patients and when the payment p is less than the cost of treating the most severely ill patient (that is, when $p<c^H$).

Proof (See Appendix A.)

Ma suggests a mixed payment system to induce the first-best level of effort even when dumping is possible. The proposed mechanism pays the hospital according to the schedule $p(c)=c^*$ for $c \le c^*$ and $p(c)=c$ for $c>c^*$. In other words, the hospital is paid a fixed fee of c^* or actual realized costs, whichever is greater. The value of c^* is determined by

$$\int_{\underline{c}}^{c^H}(p^*-c)\,dF(c;e^*)-\psi'(e^*)=\int_{\underline{c}}^{c^*}(c^*-c)\,dF(c;e^*)-\psi'(e^*), \tag{4}$$

or

$$\int_{\underline{c}}^{p^*}(p^*-c)\,dF(c,e^*)=\int_{\underline{c}}^{c^*}(c^*-c)\,dF(c;e^*) \tag{5}$$

where p^* is the optimal prospective payment when the hospital cannot dump high-cost patients.

When dumping is possible, the hospital will only treat a patient if promised payment is at least as great as the patient's realized treatment cost. A mixed payment system prevents dumping by ensuring that the payment the hospital receives for treating a patient equals or exceeds the patient's realized treatment cost. However, a mixed payment system does not provide ideal incentives for cost containment since the hospital is not responsible for the costs of treating high-cost patients. Consequently, the hospital will choose effort to minimize the expected costs of treating only those patients for whom it bears all treatment costs. The resulting level of cost reducing effort will generally differ from the first-best.

Proposition 1. A mixed payment system in the class examined by Ma can induce the first-best level of cost containment only if

$$\int_{c^*}^{c^H} F_e(c;e^*)dc = 0 \tag{6}$$

Proof (See Appendix A.)

Condition (6) is restrictive. It is not satisfied by the common formulation of stochastic dominance, for example, which implies that high levels of effort systematically reduce the likelihood of high cost realizations.[5] Figure 1 illustrates how additional effort would alter the cost distribution under the assumption of first order stochastic dominance.[6] An increase in effort from e^* to $(e^* + s)$ will result in cost reduction equal to the area between the two distribution functions (area X+Y). Under cost reimbursement, the hospital can appropriate only a fraction (area X) of this cost reduction. Thus, when area Y is strictly positive a mixed payment system provides less than ideal incentives for cost reduction.

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[5] Strict first order stochastic dominance means that for $e < e_1$, $F(c; e_2) > F(c; e_1)$ for all $c \in (c^L, c^H)$.

[6] The expression used for cost reduction due to effort in Figures 1 and 2 is obtained by integrating the left hand side of equation (2) by parts. The expression for the portion of cost reduction internalized by the hospital is obtained similarly from (21).

When the assumption of first order stochastic dominance is not satisfied, additional effort reduces treatment costs of some patients and increases treatment costs of others. Such a situation may arise if, for example, effort involves a thorough screening of patients by general practitioners before referral to specialists. The screening will reduce treatment costs of patients who do not need specialized care but, by delaying referral to specialists, may increase the cost of treating those who do require specialized care.

Figure 2 illustrates how additional effort of this type may affect costs. An increase in effort from e^* to $e^* + s$ will reduce expected costs by area X+Z and increase expected costs by area Y. Under a mixed payment system, the hospital internalizes only a fraction (area X) of the change in treatment costs. A mixed payment system can induce ideal cost reduction only if cost changes that are not captured by the hospital cancel each other out (that is, if areas Z and Y in Fig. 2 are identical in size).

Distributional Concerns and Cost Reduction

Even though a mixed payment system cannot generally induce ideal cost reduction in the setting analyzed in above, Ma's key intuition about the optimality of such a mechanism turns out to be correct in other settings.[7] When the payer has distributional concerns, she will prefer a mixed payment system to either pure cost reimbursement or pure prospective payment.

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[7] This result addresses Newhouse's (1996) concern that "... the optimality of Ma's result depends on the assumption of no deadweight losses in financing the rents" earned by the hospital.

To see why this is the case suppose the payer values patient welfare more highly than hospital profit. Formally the payer maximizes a weighted sum of net patient welfare and hospital profit. The weight on net patient welfare will be denoted $\alpha \in [1/2, 1]$ and the weight on hospital profit will be $1-\alpha$ Net patient welfare is defined as the utility, W, that patients derive from treatment minus the payments delivered by Medicare or the insurance company to the health care provider Hospital profit is defined as the payment received by the provider less the production and disutility costs incurred in providing treatment The payer may value hospital profit if for example, some of it is used to finance socially desirable activities such as indigent care and medical education and research When the payer derives no benefit from hospital profit ($\alpha = 1$) her sole objective is to minimize the payments she has to make to ensure treatment for her patients. It is assumed that higher cost-reducing effort results in a better cost distribution in the sense of (strict) first order stochastic dominance The marginal benefit of effort decreases as more effort is provided so $F_{ee}(c|e) < 0$ for all $c \in (c^L, c^H)$ To guarantee an interior solution, it is assumed that $F_e(c|0) = \infty$ and $F_e(c|\infty) = 0$ for all $c \in (c^L, c^H)$.[8]

The payer designs a mechanism under which the hospital is paid prospectively for low-cost patients, and reimbursed realized costs for treating high cost patients Formally, the hospital will be paid p if realized treatment costs do not exceed p and will be reimbursed fully for costs if these costs exceed p.[9]

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[8] Notice that the support of the cost distribution $[c^L, c^H]$ is not altered by effort.

The payer's problem is to

$$\max_{p}[\alpha(W - pF(p;e(p)) - \int_{p}^{c^H} cf(c;e(p))dc) + (1-\alpha)(pF(p;e(p)) - \int_{c^L}^{p} cf(c,e(p))dc - \psi(e(p)))] \qquad [P]$$

where $e(p)$ is the level of effort the hospital will supply when the prospective payment equals p.

Proposition 2. The solution to [P] is a fully prospective mechanism only when the payer values patient welfare and hospital profit equally ($\alpha = 1/2$). The solution to [P] involves a mixed payment system when the payer values patient welfare more highly than hospital profit ($\alpha \in (1/2,1]$). The prospective payment increases with the payer's valuation of hospital profit (that is, p decreases as α increases).

Proof: (See Appendix A.)

The optimal extent of prospective payment in the mixed system increases with the payer's valuation of hospital profit. This relationship arises from a trade off between the payer's attempts to encourage cost containment and her attempts to limit hospital profit. A more prospective payment mechanism reduces operating costs as the hospital internalizes a larger portion of costs. However, a more prospective mechanism also increases the profit that the hospital commands due to its superior knowledge of its operations. When the payer values hospital profit as highly as patient welfare (as in Ma's analysis), she chooses the payment system to achieve efficiency in production and thus maximize the sum of patient welfare and hospital profit. The payer with these preferences will induce ideal cost containment and will prefer a pure prospective payment system to a mixed payment system. When the payer values patient welfare more highly than hospital profit, a fully prospective payment mechanism is no longer optimal. The payer is willing to tolerate some productive inefficiency in order to limit hospital profit. This is achieved by reimbursing the hospital for the realized costs of treating some high-cost patients.

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[9] Notice that this class of payment mechanisms incorporates full prospective payment (if $p=c^H$), cost reimbursement (if $p=c^L$), and mixed payment systems (if $p \in (c^L, c^H)$) as special cases.

Conclusion

This note extends Ma's important work in trying to achieve a better understanding of the incentive effects of the two most widely observed payment systems in the health care industry. The note points out that while cost reimbursement for high-cost patients can eliminate dumping by health care providers, it also alters cost containment incentives from the ideal level. The note also shows that the optimal combination of prospective payment and cost reimbursement in a mixed payment system depends on how highly the payer values hospital profit. A payer who values hospital profit as highly as patient welfare is concerned solely with efficiency issues and will induce ideal cost containment by using (pure) prospective payment. However, when the payer has distributional concerns and values patient welfare more highly than hospital profit she will use a mixed payment system to balance cost containment and profit limitation[10]

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[10] Thus, the model suggests that a payer such as a competitive insurance company that derives little or no benefit from hospital rents will prefer payment systems that pay for a large proportion of patients by cost reimbursement. Payers who are not strongly averse to hospital rents (perhaps some public payers such as Medicare) will prefer a more prospective payment system

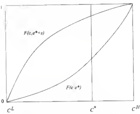

Figure 1 Cost Reduction When First Order Stochastic Dominance is Satisfied.

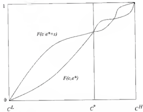

Figure 2 Cost Reduction When First Order Stochastic Dominance is not Satisfied

COMPETITION AND MARKET STRUCTURE IN THE HEALTH CARE INDUSTRY

Introduction

The health care industry is currently undergoing rapid and dramatic changes. One important feature of these changes is the increasingly vigorous competition among providers of health care. Another is the increasing presence of health maintenance organizations (HMOs) in what was, until recently, a market dominated by indemnity providers of health care. I model competition between HMOs and between hospitals that serve patients with indemnity insurance to provide predictions about the types of insurance contracts and the quality of treatment that will be available to consumers under different systems of health care delivery.

I find that competitive indemnity insurance companies whose enrollees obtain treatment from independent hospitals do not provide consumers with full insurance. When insurers have to rely on hospitals' reports of patient needs, they use copayments to ration the quality of treatment obtained by patients. Copayments force patients to bear directly some of the cost of treatment, so patients facing copayments limit the quality of treatment that they obtain. In an indemnity setting, lower copayment rates benefit risk-averse consumers by providing them with more insurance against the financial costs of hospital treatment. However, lower copayment rates also induce patients to demand inefficiently high treatment quality since they do not internalize the full cost of higher quality treatment. This fact leads the hospitals who serve indemnity patients to compete excessively on treatment quality so that patients marginal utility of income exceeds the benefits they derive from higher quality treatment. This inefficiency becomes more pronounced as copayment rates decrease.

In comparison to indemnity insurers who allow their enrollees freedom of provider choice, HMOs have greater control over providers and can better enforce desired quality levels without having to resort to copayments. HMOs allocate risk efficiently and provide their customers with full insurance against the financial costs of treatment. Risk averse consumers are fully insured and all financial risk is borne by the risk neutral HMOs.

HMOs do not face the incentives that hospitals serving indemnity patients have to provide inefficiently high quality treatment. This does not necessarily imply, however, that HMO patients receive lower quality treatment than patients with indemnity insurance. In general, the quality of treatment provided by HMOs may be higher or lower than the quality of treatment provided by hospitals serving patients with indemnity insurance. The quality of treatment provided by HMOs is most likely to exceed that provided by hospitals serving indemnity patients when the patients are severely sick and indemnity patients have to make large copayments. Severely sick indemnity patients then have less residual wealth and a higher marginal utility of income than the better insured HMO patients.

Consequently, they may demand lower quality treatment than similarly sick HMO patients.[1]

Dranove, Satterthwaite, and Sindelar (1986) were among the first to examine the effects of competition among health care providers. They analyze the effects of price competition among hospitals that function in a monopolistically competitive market. Pope (1989) examines non-price competition among health care providers who are reimbursed through Medicare's Prospective Payment System. In the model presented here, health care providers compete for patients on the quality of treatment they provide, and on the price they charge for the treatment. Ma and Burgess (1993) examine a model in which patients have different preferences for two competing hospitals. The hospitals first select the quality of treatment they will provide to their patients, and then compete on the price they charge for the treatment. Lyon and Huang (1997) use a model similar to mine to analyze the effects of competition among health care providers when investment improves treatment quality stochastically. They examine the effects of competition among hospitals whose patients are free to obtain treatment from their preferred health care provider, as well as among HMOs whose enrollees' choice of provider is limited. Wolinsky (1995) examines how the outcomes of managed competition among health care providers compare to the outcomes achieved when providers are regulated regional monopolists. Ma and Burgess, Lyon and Huang, and Wolinsky all assume that consumers are risk neutral, so risk allocation issues do not arise in their models. Analysis of how risk is allocated between risk neutral firms and risk averse consumers is central to the analysis in this paper. Ellis (1997) uses a model of competition among health care providers to analyze how much treatment patients who differ in severity of sickness will be provided under prospective and cost-based reimbursement rules. Che and Gale (1997) examine how a large buyer (or buyer alliance) will structure competition among potential health care suppliers. Consumers in the Ellis and the Che and Gale models are assumed to be fully insured. The amount of insurance consumers obtain is endogenously determined in my paper. Encinosa and Sappington (1997) consider insurance issues as well as competition among providers of health care. Their analysis focuses on competition among HMOs when only consumers know their risk of requiring treatment. I examine the insurance contracts and quality of treatment that HMO and indemnity patients will receive when their risk levels are observable to all concerned parties.

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[1] Similar income effects in the health care context are analyzed in greater detail in Ma and Riordan (1997).

The results of the Rothschild-Stiglitz (1976) model have been criticized as unrealistic by some health care economists for predicting that high risk consumers can obtain the insurance they desire while low risk consumers can not. It has been argued that it is high-risk individuals who have problems obtaining insurance in practice, for example because of pre-existing conditions. The results of this paper suggest that this criticism of Rothschild Stiglitz may be misdirected. While the Rothschild Stiglitz model analyzes insurance markets where individuals risk levels are not known, the individuals who have trouble buying the desired amount of health insurance in practice are often those with *verifiable* pre-existing conditions. That is, the fact that they are at a high-risk of requiring expensive treatment is *known* This paper shows that when individuals risk levels are known the contracts insurance companies provide high-risk consumers differ from those they provide low risk consumers These high risk consumers would be refused coverage if they tried to purchase the insurance contracts designed for low risk consumers This is precisely the phenomenon observed in the health care industry

The rest of the paper is organized as follows The next section describes the basic elements of the model The third section characterizes the outcome of competition among indemnity providers of health care. Then I characterize the outcome of competition among HMOs The fifth section compares the outcome of competition among providers who serve indemnity patients to the outcome of competition among HMOs. The final section summarizes the conclusions of this paper and provides directions for further research

The Basic Model

The basic model consists of a city of unit length with one health care provider located at either end Consumers living in the city can be either severely sick or not severely sick. The treatment consumers require when not severely sick can be viewed as either check ups and preventive care or as care required by individuals who are not seriously ill Severe sickness poses a greater threat to a patient's life and well being

Consumers can be at either high-risk or low-risk of becoming severely sick. High risk consumers are more likely to become severely sick than low risk consumers The probability that a consumer becomes severely sick is denoted

f^i, $i = h, l$ where $1 > f^h > f^l > 0$ and the superscripts h and l denote high risk and low-risk consumers, respectively. Consumers' risk levels are assumed to be observable. For example, risk levels could be based on the presence of observable and verifiable individual characteristics such as pre-existing medical conditions or smoking behavior.[2] The proportion of high-risk consumers in the city's population is denoted b where $1 > b > 0$. The total number of consumers in the city is normalized to one.

Both types of consumers are uniformly distributed along the city. The differences in their locations can reflect consumers' geographical locations as well as varying preferences for particular physicians' practice styles, etc. When consumers require treatment, they obtain it from one of the providers and incur a cost of t per unit distance in doing so. High values of t can denote high transportation costs as well as strong consumer preferences for the provider who most closely meets their tastes. High transportation costs and strong preferences for particular physicians or practice styles make it less likely that consumers will switch providers. Thus, high values of t also denote less competition between health care providers. If the providers located at the left and right ends of the city are labeled A and B respectively, and each consumer's location is defined as his distance from provider A, then a consumer located at d incurs transportation costs of dt when he obtains treatment from provider A and $(1-d)t$ when he obtains treatment from provider B

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[2] An understanding of the types of insurance contracts and treatment available to individuals whose risk levels are known is particularly important in light of the recent development of genetic tests that reveal individuals' degree of susceptibility to serious diseases. See, for example, Waldholz (1997) and "A Question of Genes: Inherited Risks", a documentary film produced by Oregon Public Broadcasting.

The quality of treatment received by consumers reflects both access to costly medical procedures and amenities that render treatment more comfortable. Higher quality treatment improves the patient's health and thereby increases the benefits he derives from health. A patient who is not severely sick enjoys utility $H(n+q)$ from health when he receives treatment of quality q, where $H(q)$ is an increasing concave function (i.e., $H'(q) > 0$ and $H''(q) < 0$). The corresponding utility from health for a severely sick patient is $H(s+q)$ where $n > s$. Intuitively, the severe illness reduces the patient's utility from health and increases his marginal valuation of treatment intensity. For expositional ease, n is normalized to zero hereafter, so $s < 0$. To ensure that all patients obtain positive levels of treatment quality, it is assumed that $H'(q) = \infty$ for all $q \leq 0$, $\lim_{q \to 0} H'(q) = \infty$, and $\lim_{q \to \infty} H'(q) = 0$. Provision of higher quality treatment is costly to health care providers. The cost of providing treatment of quality q is normalized to q dollars per treated patient.

Consumers' utilities are assumed to be separable in health and income. Each consumer has an income of y dollars and obtains utility $u(y-e)$ from income when he spends e dollars on health care. Thus, a patient who spends e dollars on health care and receives treatment of quality q enjoys total utility $u(y-e) + H(s+q)$ when he is severely sick and $u(y-e) + H(q)$ when he is not severely sick. Consumer utility increases at a decreasing rate with income (i.e.

$u'(y) > 0$ and $u''(y) < 0$). The marginal utility of income is very large at low levels of income but very small when income is large (i.e., $\lim_{y \to 0} u'(y) = \infty$ and $\lim_{y \to \infty} u'(y) = 0$).

Competition between Indemnity Providers of Health Care

This section analyzes competition between health care providers serving patients with indemnity insurance. Consumers first contract with competitive insurance companies that provide indemnity against the financial costs of hospital treatment. Consumers visit one of the health care providers when they require treatment.

The health care providers A and B are profit-maximizing hospitals that treat patients who have bought indemnity insurance. The hospitals compete for patients on the quality of treatment they provide and on the price they charge for the treatment. q_j^{is} and q_j^{in} are the quality of treatment hospital j provides to type i patients who are severely and not severely sick, respectively. Similarly, p_j^{is} and p_j^{in} are the prices hospital j charges type i patients for treatment when they are severely and not severely sick, respectively. Insurance companies charge consumers a fee or "premium" in return for paying part of the cost of hospital treatment. The contract offered by competitive insurance companies to type i consumers is denoted (T^i, δ^i), $i = h, l$. T^i is the premium paid by type i consumers and $\delta^i \in [0, 1]$ is the copayment rate or the fraction of treatment costs borne directly by type i consumers.

Consumers can observe the quality of treatment provided by the hospitals, possibly from the reputation of the hospitals. The hospital and the patient can also observe the severity of the patient's sickness. Insurers obtain from hospitals information about the patients' severity of sickness and the treatment provided to them.[3] Hospitals are assumed to be willing to misreport patients' severity of sickness if doing so does not reduce their profits and makes their patients better off.

Hospital Competition

Consider first the hospitals' decisions regarding the quality of treatment they provide and the prices they charge. For simplicity assume that all patients buy health insurance, and obtain treatment from one of the two hospitals when they require it. Patients obtain treatment from the hospital that provides them with the highest net utility. Let d_A^s be the location of the severely sick type i patient who is indifferent between obtaining treatment at the two hospitals. That is,

$$u(y-T^s-\delta\ p_A^s) + H(s+q_A^s) - t d_A^s = u(y-T^s-\delta\ p_B^s) + H(s+q_B^s) - t(1-d_A^s) \quad (7)$$

Then, all severely sick type s patients located to the left of d_A^s will obtain treatment from hospital A while those located to the right of d_A^s will obtain treatment from hospital B. Thus

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[3] Insurers typically obtain information on patients' severity of sickness and the treatment provided to them from the invoices and treatment records provided by hospitals as part of the billing process. Insurers could obtain corroborating treatment and severity information from patients. However, this information may not be reliable enough to incorporate into contracts. Similarly, it is difficult to write contracts on the basis of reputational information. For example, an insurer may know that a hospital has the (deserved) reputation for providing low quality treatment but may find it difficult to litigate in a court of law on the basis of the hospital's reputation.

$d_A^{is} = \{u(y - T^i - \delta\, p_A^{is}) + H(s+q_A^{is}) - u(y - T^i - \delta\, p_B^{is}) - H(s+q_B^{is}) + t\}/2t$ is the fraction of severely sick type i patients who obtain treatment at hospital A. Similarly

$d_A^{in} = \{u(y - T^i - \delta\, p_A^{in}) + H(q_A^{in}) - u(y - T^i - \delta'\, p_B^{in}) - H(q_B^{in}) + t\}/2t$ is the fraction of type i patients who are not severely sick who obtain treatment at hospital A. Hospital A chooses p_A^{ik} and q_A^{ik}, $i = h, l$; $k = s,n$ to maximize $[\pi_{Hosp}]$[4]

$$\begin{aligned} & b\{f^h[(p_A^{hs} - q_A^{hs})\, d_A^{hs}] + (1 - f^h)[(p_A^{hn} - q_A^{hn})\, d_A^{hn}]\} + \\ & (1-b)\{f^l[(p_A^{ls} - q_A^{ls})\, d_A^{ls}] + (1 - f^l)[(p_A^{ln} - q_A^{ln})\, d_A^{ln}]\} \end{aligned} \quad [\pi_{Hosp}]$$

The first order necessary conditions with respect to hospital A's quality choices can be solved to yield the following expressions for the prices charged by the hospital

$$p_A^{is} = \frac{2\, t\, d_A^{is}}{H'(s + q_A^{is})} + q_A^{is} \tag{8}$$

$$p_A^{in} = \frac{2\, t\, d_A^{in}}{H'(q_A^{in})} + q_A^{in} \tag{9}$$

These can be substituted into the expressions for d_A^{is}, d_A^{in} and $[\pi_{Hosp}]$ to eliminate p_A^{is} and p_A^{in} from hospital A's profit maximization problem. Hospital A then chooses q_A^{is} and q_A^{in} to maximize its profit. The first order necessary conditions with respect to q_A^s and q_A^n can be written as equations (10) and (11) respectively

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[4] Since the hospitals considered here are ex ante symmetric, the analysis that follows is limited to symmetric equilibria. The expressions for the hospitals' profits, profit maximizing first order conditions, etc. are symmetric. Therefore, only expressions relevant to hospital A's decisions are presented.

$$-\delta\ u'(y-T^s-\delta\ p_A^s) + H'(s+q_A^s) = 0 \tag{10}$$

$$-\delta\ u'(y-T^n-\delta\ p_A^n) + H'(q_A^n) = 0 \tag{11}$$

Proposition 1 In this indemnity setting, (a) severely sick patients receive higher quality care than do patients who are not severely sick (b) severely sick patients are charged higher prices for the care they receive than patients who are not severely sick, and (c) hospitals earn more profit per patient on patients who are not severely sick than on patients who are severely sick

Proof (See Appendix B.)

Since patients who are severely sick value higher quality treatment more than patients who are not severely sick the hospitals provide them with higher quality treatment. Severely sick patients are more expensive to treat than patients who are not severely sick, so the price that hospitals charge for treating them is higher than the price that hospitals charge for treating patients who are not severely sick. Because they pay more for the care they receive, severely sick patients have less residual wealth, and thus a higher marginal utility of income than patients who are not severely sick. Consequently patients who are severely sick are particularly sensitive to price increases, and so the competing hospitals set a price closer to cost for severely sick patients. As a result in equilibrium, hospitals earn more profit per patient on patients who are not severely sick than on those who are severely sick

As will be shown later, non-trivial indemnity contracts that are profitable for insurers and attractive to consumers will not always exist. However when such contracts do exist (as postulated in Assumption 1) they give rise to the outcomes described in Proposition 2.

Assumption 1. There exists an insurance contract with $\delta < 1$ that leaves type i consumers at least as well off as they would be without insurance and allows insurance companies to earn zero (extranormal) profit.[5]

Proposition 2. When Assumption 1 holds the quality of treatment provided by the hospitals is excessive in the sense that patients' marginal utility of income exceeds the additional benefits they derive from higher quality treatment. This inefficiency is more pronounced for patients who face lower copayment rates.

Proof (See Appendix B.)

Copayments are used by indemnity insurers as a way of rationing patients' demand for higher quality treatment. However risk averse consumers value insurance and so may not be compelled to bear the full additional costs of the treatment they receive. When patients are insured and face copayment rates less than one, they do not internalize the full cost of higher quality treatment. Therefore hospitals serving them compete excessively on quality so that patients' marginal utility of income exceeds the additional benefits they derive from higher quality treatment. This inefficiency is more pronounced for patients who face low copayment rates. The central finding here is that hospitals compete aggressively for well-insured patients by providing them with inefficiently high quality treatment.

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[5] When the copayment rate $\delta^i = 1$, type i consumers make out-of-pocket payments for the full cost of hospital treatment. This is equivalent to no insurance. A sufficient condition for Assumption 1 to hold is that $-\lambda y$

Provision of Insurance

Now consider the insurance contracts that will be offered to the two types of consumers. Since insurance companies are competitive they make zero profits. Also the insurance companies cannot employ profits derived from one type of consumer to sustain losses on the other type of consumer. If an insurance company engaged in such cross-subsidization, another insurance company could attract only the profitable consumers and refuse to serve the unprofitable consumers, thereby making strictly positive profit.[8] Therefore the premium that insurance companies charge a type *i* consumer equals the expected payment they have to make to pay for the consumer's treatment. Thus

$$T^i = f(1-\delta^i)p^{*} + (1-f)(1-\delta'^i)p^{*} \qquad (12)$$

Substituting equations (8) and (9) into equation (12) and using the fact that at a symmetric equilibrium the two hospitals share the market equally so that $d_A^{i} = d_A^{*} = 1/2$, yields

$$T^i = f(1-\delta'^i)\left[\frac{t}{H'(s+q'^*)}+q^*\right]+(1-f)(1-\delta^i)\left[\frac{t}{H(q^*)}+q^*\right]. \qquad (13)$$

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[8] The model presented here assumes that competitive insurance companies face no fixed costs of operation. Cross-subsidization may be possible if economies of scale exist in the insurance market. See Encinosa and Sappington (1997).

Recall that insurance companies rely on the hospitals' reports regarding the severity of a patient's sickness. Lemma 1 summarizes the hospitals' incentives to misrepresent the severity of a patient's sickness.

Lemma 1. A hospital's profit decreases when it misreports the severity of a severely sick patient's sickness. The hospital's profit increases when it misreports the severity of sickness of a patient who is not severely sick.

Proof: (See Appendix B.)

Since the profit-maximizing hospitals are assumed to be willing to misreport patients' severity of sickness only if doing so does not reduce profits and benefits their patients, the hospitals will not misreport severely sick patients' level of sickness.[7] However, the hospitals would be willing to exaggerate the severity of sickness of patients who were not severely sick if doing so made their patients better off. Therefore, to ensure truthful reporting of patients' severity of sickness, the insurance company must ensure that

$$u(y-T^i-\delta^i p^n) + H(q^n) \geq u(y-T^i-\delta^i p^{s}) + H(q^{*}), \qquad \text{(IC N)}$$

where q^{*} is the quality of treatment competing hospitals provide to patients who are not severely sick when they exaggerate the patients' severity of sickness.

The expected utility a type i consumer obtains from purchasing insurance from one of the competitive insurance companies is given by

$$f^i[u(y-T^i-\delta^i p^{s}) + H(s+q^{s})] + (1-f^i)[u(y-T^i-\delta^i p^{n}) + H(q^{n})]. \qquad \text{[EU]}$$

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[7] Fear of malpractice claims may also prevent hospitals from skimping on care for patients who are severely sick.

where p', p'' and T' are defined by equations (8), (9) and (13), respectively. Competitive insurance companies select copayment and quality levels to maximize [EU] subject to (10), (11), and (IC-N).

Proposition 3. Competitive companies that provide indemnity insurance to consumers who obtain treatment from independent hospitals do not fully insure their enrollees.

Proof: (See Appendix B.)

Insurance companies do not provide full insurance to consumers in order to ration the quality of treatment they obtain when they are not severely sick. If the insurance companies did not require copayments, hospitals would report patients who were not severely sick to be severely sick in order to provide them with higher quality treatment. (Formally, (IC-N) would be violated.)

Numerical computer simulations of the model described above provide additional insights into the type of contracts that will be available to consumers who purchase indemnity insurance. They show that the amount of insurance obtained by consumers can either increase or decrease with consumers' risk levels. The simulations also provide an insight into the reasons why insurers use deductibles in indemnity contracts.[8]

Proposition 4. The copayment rates faced by high-risk consumers can be higher or lower than those faced by low-risk consumers. Thus high-risk consumers can obtain either more or less insurance than low-risk consumers. It may sometimes be optimal for consumers to obtain no indemnity insurance at all.

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[8] The simulations presented in Tables 1 and 2 provide some insights into the contracts that will be offered to consumers. However, it is important not to ascribe undue realism to the specific parameter values and functional forms employed in the simulations.

Proof: (See Appendix B.)

Lower copayment rates benefit risk averse consumers by providing them with more insurance. Patients who face low copayments, however, bear only a small fraction of the additional costs of higher quality treatment and, therefore, demand inefficiently high quality treatment. The optimal copayment rate selected by competitive insurers balances the insurance benefits of lower copayments against their inefficiency costs. Simulation numbers 1-6 in Table 1 show that the optimal copayment rate may either increase or decrease with consumers' probability of becoming severely sick. The simulations suggest that high-risk consumers face higher or lower copayment rates than low-risk consumers depending on which of two countervailing effects predominates. Since high risk consumers are more likely to require expensive treatment, they value insurance more highly than low-risk consumers. This effect tends to reduce the copayment rate faced by high-risk consumers. High-risk consumers, however, are more expensive to insure than low-risk consumers who face the same copayment rate and obtain the same treatment, so high-risk consumers pay higher premia than low-risk consumers. The higher premia reduce high-risk consumers' residual wealth, increase their marginal utility of income, and decrease their demand for higher quality treatment. The insurers implement the lower quality treatment by imposing higher copayment rates on high-risk consumers, so this second effect tends to increase the copayment rate faced by high risk consumers. In general high-risk consumers may face higher or lower copayment rates than low-risk consumers.

Simulation numbers 6 and 7 may provide an insight into the reasons for the use of deductibles by insurance companies. When, as in simulation 6, the probability of becoming severely sick is small, the expected benefit from insurance in the unlikely event that the consumer becomes severely sick may be outweighed by the expected loss from the inefficiently high quality of treatment that insurance induces. It may then be optimal for the consumer to obtain no insurance. This situation can arise when the consumer's income is high relative to the loss he suffers when he becomes severely ill (that is, when $y > -s$). No insurance may also be optimal when, as in simulation 7, the loss the consumer suffers when he becomes severely sick is much smaller than his income, even if the probability of becoming severely sick is large. The fact that the efficiency loss from insurance-induced over-consumption of health care may outweigh the benefits of insurance may help explain the use of deductibles by indemnity insurers.

The Rothschild-Stiglitz (1976) model has been faulted by some health care economists for predicting that high-risk consumers can obtain the insurance they desire while low-risk consumers cannot. In the health care context, it has been argued, it is the high risk individuals who have problems obtaining insurance, for example because of pre-existing conditions. Proposition 4 suggests that this criticism of Rothschild-Stiglitz may be misdirected. While the Rothschild-Stiglitz model analyzes insurance markets where individuals' risk levels are not known, the individuals who have trouble buying the desired health insurance in practice are often those with *verifiable* pre-existing conditions. That is, the fact that they are at a high-risk of requiring expensive treatment is *known*. Proposition 4 shows that, as observed in the health care industry, high-risk individuals whose risk levels are known are provided different contracts than low risk consumers. These high risk individuals would be refused coverage if they tried to buy the insurance contracts designed for low-risk consumers. This is precisely the phenomenon observed in the health care industry.

Competition between HMOs

This section examines the outcome of competition between HMO providers of health care. The health care providers *A* and *B* are profit maximizing HMOs that own the treatment facilities located at the left and right ends of the city respectively.

An important difference between HMOs and indemnity providers of health care is the way in which they determine the quality of treatment and the amount of insurance provided to consumers. Under the indemnity insurance system, health care services and insurance are provided by different sets of firms. HMOs combine provision of health care services with the provision of insurance to determine the quality of treatment provided as well as the premia and copayments charged to their enrollees.[9]

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[9] Even when they do not own treatment facilities, HMOs generally are more closely connected to the providers from whom their enrollees can obtain treatment than indemnity insurers who do not restrict their customers' freedom of provider choice. Miller and Luft (1994) observe that "Compared with indemnity plans, HMO plans appear to have lower hospital bed use because they can implement a much wider array of methods of affecting physician practice, including physician selection, retention, and information feedback procedures, formal and informal UM (utilization management), and provider reimbursement and risk sharing."

The contract offered by HMO j to a type i consumer is given by $(T_j^{i'}, T_j^{i''}, q_j^{i'}, q_j^{i''})$, $i = h, l$. $T_j^{i'}$ and $T_j^{i''}$ are the payments made to the HMO by the type i consumer when he is severely sick and not severely sick, respectively. Thus, $T_j^{i'}$ and $T_j^{i''}$ are the sum of insurance premium and copayments made by a type i consumer who contracts with HMO j. $q_j^{i'}$ and $q_j^{i''}$ are the quality of treatment provided by the HMO to a type i consumer when he is severely and not severely sick, respectively.

Consumers can observe the quality of treatment provided by the HMOs. Consumers' information on the quality of treatment provided could, for example, be based on the reputation of the HMOs. HMOs are assumed to be able to observe the quality of treatment provided to their enrollees. This may be because, as in this model, the HMOs own the facilities at which treatment is provided and have ready access to treatment records. Alternately, HMOs may have contractual agreements with hospitals, physicians, etc. that allow them to monitor the care provided to their enrollees.

Consumers contract with HMOs before the severity of their sickness is realized. So consumers contract with the HMO that provides them with the highest expected utility. Let d_A denote the location of the type i consumer who derives equal expected utility by contracting with either of the two HMOs. That is,

$$f_i[u(y - T_A^{i'}) + H(s + q_A^{i'}) - d_A t] + (1 - f_i)[u(y - T_A^{i''}) + H(q_A^{i''}) - d_A t] =$$
$$f_i[u(y - T_B^{i'}) + H(s + q_B^{i'}) - (1 - d_A) t] + (1 - f_i)[u(y - T_B^{i''}) + H(q_B^{i''}) - (1 - d_A) t]$$

For simplicity, assume that all consumers contract with one of the two HMOs. All type i consumers located to the left of d_A will contract with HMO A, while those located to the right of d_A will contract with HMO B. The number of high risk and low risk consumers who contract with HMO A is then given by $b\,d_A^h$ and $(1-b)\,d_A^l$, respectively, where for $i = h, l$

$$d_A = \{f^i\,[u(y - T_A^{i*}) + H(s + q_A^{i*}) - u(y - T_B^{i*}) - H(s + q_B^{i*})] + (1 - f^i)[u(y - T_A^{in}) + H(q_A^{in}) - u(y - T_A^{in}) - H(q_A^{in})] + t\}/2t$$

The problem faced by the profit maximizing HMO A is to choose T_i^{*}, T_i^{n}, q_i^{*} and q_i^{n} to maximize$[\pi_{HMO}]$[17]

$$\begin{aligned} &b\,d_A^h\{f^h[T_A^{h*} - q_A^{h*}] + (1 - f^h)[T_A^{hn} - q_A^{hn}]\} + \\ &(1 - b)\,d_A^l\{f^l[T_A^{l*} - q_A^{l*}] + (1 - f^l)[T_A^{ln} - q_A^{ln}]\} \end{aligned} \qquad [\pi_{HMO}]$$

Proposition 5 HMOs provide full insurance to both types of consumers. The quality of treatment provided by the HMOs is efficient in the sense that consumers' marginal utility of income equals the additional benefits they derive from higher quality treatment. HMOs charge high-risk consumers higher premia than low-risk consumers.

Proof: (See Appendix B.)

In contrast to insurance companies whose enrollees obtain treatment at independent hospitals, HMOs do not have to use copayments to ration the quality of treatment provided to their enrollees. They have greater control over providers and can better enforce desired quality levels without having to resort to copayments. HMOs maximize profits by allocating risk efficiently. Risk averse consumers are fully insured and all financial risk is borne by risk neutral HMOs. If the HMOs were not providing the efficient amount of insurance, one HMO could increase its profits by providing full insurance and extracting the resulting additional surplus by increasing premia. Also, unlike hospitals competing for indemnity patients, HMOs have an incentive to provide the efficient quality of treatment. To see why, consider two competing HMOs that were providing inefficient treatment quality. Then, one of them could increase its profits by providing consumers with efficient treatment quality and extracting the resulting additional consumer surplus by requiring consumers to pay more.

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[17] Like the hospitals analyzed in earlier, the HMOs considered here are symmetric and so the analysis is limited to symmetric equil bria. The expressions for the HMOs profits, profit maximizing first order conditions, etc. are symmetric and so only expressions relevant to HMO A's decisions are presented.

Changes in the competitiveness of the HMO market have important implications for the welfare of consumers.

Proposition 6. As transportation costs increase, the premia charged by the HMOs increase, the quality of treatment provided decreases, HMO profits increase, and consumer welfare decreases.

Proof: (See Appendix B.)

As noted earlier, high transportation costs denote less competition between providers of health care. Transportation costs can reflect the cost of physically getting to a health care provider or the utility loss that patients suffer when they obtain treatment from other than their preferred provider. If transportation costs are high, consumers will be less willing to contract with a more distant firm. The nearer HMO will exploit consumers' unwillingness to contract with its rival by extracting a larger portion of consumer surplus through higher premia. The higher premia increase consumers' marginal utility of income. This causes a decrease in the quality of treatment demanded by consumers. Since the two HMOs are symmetric, they respond identically to higher transportation costs. Thus, as long as consumers continue to contract with one of the two HMOs, the number of individuals enrolled in each HMO is not altered by higher transportation costs. Since higher transportation costs result in higher premia and lower quality treatment while leaving the number of enrollees in each HMO unaltered, higher transportation costs lead to higher HMO profits and leave consumers less well off.

A Comparison of the Outcomes of Competition: HMOs vs. Indemnity Providers

The key difference between HMO and indemnity provision of health care as they are modeled in this paper is that HMOs' ability to observe the quality of treatment provided to their enrollees enables them to combine treatment decisions with decisions on the amount of insurance provided to consumers. This section compares the outcomes of hospital competition in an indemnity setting to the outcomes of competition among HMOs.[11]

Unlike indemnity insurers whose enrollees obtain treatment from independent hospitals, HMOs do not have to use copayments to ration treatment quality and can provide their consumers with full insurance.

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[11] Some of the results presented here follow immediately from the analysis in previous sections. They are repeated here to facilitate direct comparison.

Proposition 7. HMOs provide their enrollees with more insurance than competitive indemnity insurers whose customers obtain treatment from independent hospitals [12]

Proof (See Appendix B)

HMOs that can observe the quality of treatment provided to their customers maximize profits by allocating risk efficiently The risk neutral HMOs insure their enrollees fully against the financial costs of hospital treatment Indemnity insurers have to use copayments to ration the quality of treatment obtained by their enrollees When the loss from insurance-induced over consumption of health care is greater than the benefit consumers derive from insurance competitive insurance companies use deductibles to make consumers bear the full cost of treatment. So indemnity insurers provide their customers with less insurance than HMOs

The impact of an increasing HMO presence in the health care industry on the quality of treatment received by patients is of great interest to policymakers. Proposition 8 shows that in general it is unclear whether HMOs will provide their customers with higher or lower quality treatment than hospitals serving patients with indemnity insurance

Proposition 8 The quality of treatment provided by the HMOs may be higher or lower than the quality of treatment provided by hospitals serving patients with indemnity insurance

Proof (See Appendix B)

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[12] I use the term "more insurance" to mean that HMO patients have to make lower copayments than patients with indemnity insurance

As shown in earlier the treatment HMO patients receive is such that the additional benefits of higher quality treatment equal patients marginal utility of income Patients with indemnity insurance do not bear the full cost of higher quality treatment and have an incentive to demand inefficiently high quality treatment This does not imply, however that HMO patients always receive lower quality treatment than patients with indemnity insurance Numerical simulations suggest that the quality of treatment provided by HMOs is most likely to exceed that provided by hospitals serving indemnity patients when the patients are severely sick and indemnity patients have to make large copayments Severely sick indemnity patients then have less residual wealth and a higher marginal utility of income than the better insured HMO patients Consequently they may demand lower quality treatment than similarly sick HMO patients

Table 1 lists the results of numerical computer simulations of the contract that will be offered by indemnity insurers to different types of consumers Table 2 lists the contracts that will be offered by HMOs to the same consumers Comparing the data in Tables 1 and 2 shows that the quality of treatment provided by HMOs may be higher or lower than the quality of treatment provided by hospitals serving indemnity patients Note that consumers expected utility is higher when they contract with the HMOs than when they buy insurance from indemnity providers in all simulations This is due to the fact that HMOs provide more insurance than indemnity insurers and that HMO consumers do not have the incentives to over-consume health care that are faced by patients with indemnity insurance

Conclusion and Extensions

This paper examines the types of insurance contracts and the quality of treatment that will be available to consumers who contact with HMOs and competing indemnity providers of health care. I find that indemnity insurers make consumers bear part of the cost of their treatment directly through copayments and deductibles and so do not provide their enrollees with full insurance. Hospitals treating patients with indemnity insurance compete aggressively for well insured patients by providing them with inefficiently high quality treatment. I find that HMOs fully insure their enrollees against the financial costs of treatment. HMOs provide patients with treatment quality such that their marginal utility of income equals the additional benefits they obtain from higher quality treatment. The analysis in this paper also reveals important ambiguities about the health care market. The copayments high-risk consumers have to make may be higher or lower than those faced by low-risk consumers. Competitive indemnity insurers offer the contract that best balances the insurance benefits of lower copayments against the costs of the inefficiently high quality treatment they induce. I also find that the quality of treatment provided by HMOs may be higher or lower than the quality of treatment provided by hospitals serving patients with indemnity insurance.

The analysis presented in this paper provides some insights regarding the insurance contracts and the quality of treatment that consumers will obtain under different systems of health care delivery. However, a number of issues warrant further investigation. One venue for further research is to examine the insurance and treatment that consumers will obtain in a multi period setting when current treatment serves to prevent future illness. Another is to examine how the insurance contracts and the quality of treatment consumers are provided are affected by consumers' ability to periodically change the type of insurance they purchase. This paper assumes that consumers can observe the quality of treatment they receive. The patient-physician relationship warrants modelling in greater detail in order to examine how the treatment patients are provided is affected by their inability to observe perfectly the treatment they require and receive. Imperfect HMO control of physician activity also merits investigation as do models that incorporate additional elements of adverse selection and moral hazard.

Table 1.

Results of Numerical Simulations of the Contract Offered by Indemnity Insurers

$u(y)=y^{0.5}$ $H(q^s)=(q^s)^{0.5}$ $H(s+q^l)=(s+q^l)^{0.5}$

Simulation #	1	2	3	4	5	6	7	8	9	10
Income (y)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Transportation Cost (t)	4	4	4	4	4	4	4	3	2	0
Loss from Severe Sickness (-s)	4000	4000	1500	1500	1500	1500	400	4000	4000	4000
Prob. Severe Sickness (f)	0.3	0.25	0.8	0.6	0.1	0.05	0.6	0.3	0.3	0.3
Insurance Premium ($\bar{I}$)	989.76	797.10	414.50	367.93	25.41	0	0	992.38	998.04	1032.04
Copayment rate ($\bar{\delta}$)	0.23	0.26	0.66	0.61	0.86	1	1	0.22	0.21	0.16
Treatment quality-severe (q^s)	4006.78	4006.7	1502.72	1503.2	1501.8	1501.44	402.82	4008.23	4010.0	4018.5
Treatment quality-not severe	14.31	12.49	3.62	4.14	2.67	2.15	2.15	15.29	16.78	24.9
Treatment price-severe (p^s)	4057.66	4057.2	1539.54	1533.8	1523.3	1518.64	423.82	4051.96	4043.6	4018.5
Treatment price-not severe (p^n)	100.18	90.57	36.43	40.28	28.19	24.96	24.96	82.78	64.76	24.8
Consumer's total utility-severe	32.41	52.06	161.79	190.46	183.11	141.07	362.71	45.81	61.51	108.51
Consumer's total utility-not	250.81	238.70	360.23	368.78	429.84	434.23	434.23	251.31	251.21	246.56
Consumer's total expected utility	185.29	227.54	201.48	261.78	405.17	418.57	412.78	189.66	194.31	205.15
Per patient hosp. Profit-severe	50.88	50.53	26.83	30.54	21.41	17.20	21.80	43.73	33.55	0
Per patient hosp. Profit not	85.87	78.08	32.81	36.06	26.52	22.81	22.81	67.48	47.99	0
Per patient Expected hosp. Profit	75.37	71.19	28.06	32.75	25.01	22.53	22.20	60.36	43.66	0

Table 2.

Results of Numerical Simulations of the Contract Offered by HMOs										
$u(y)=y^{0.6}$ $H(q^{1})=(q^{1})^{0.5}$ $H(s+q^{2})=(q^{2})^{0.5}$										
Simulation #	1	2	3	4	5	6	7	8	9	10
Income (y)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Transportation Cost (t)	4	4	4	4	4	4	4	3	2	6
Loss from Severe Sickness (-s)	4000	4000	1500	1500	1500	1500	400	4000	4000	4000
Prob. Severe Sickness (f)	0.3	0.25	0.8	0.6	0.1	0.05	0.6	0.3	0.3	0.3
Premium (T)	1220.5	1021.5	1220.59	1077.98	174.56	99.76	264.30	1215.8	1211.1	1201.68
Treatment quality-severe (q^{1})	4001.6	4001.7	1501.65	1501.81	1502.1	1502.1	402.08	4001.6	1.656	1.676
Treatment quality-not severe	1.65	1.76	1.65	1.81	2.11	2.13	2.08	1.65	1.656	1.676
Consumer's total utility severe	206.95	246.03	206.95	267.94	467.78	421.06	391.71	207.94	208.94	210.94
Consumer's total utility-not severe	206.95	246.03	206.95	267.94	467.78	421.06	391.71	207.94	208.94	210.94
Consumer's total expected utility	206.95	246.03	206.95	267.94	467.76	421.06	391.71	207.94	208.94	210.94
Expected HMO Profit per	16.94	19.82	18.94	20.21	22.45	22.63	22.23	14.22	9.49	8

COMPETITION, MANAGED CARE AND HOSPITAL PRICING

Introduction

This paper examines the pricing behavior of for-profit and nonprofit hospitals focusing on the impact that competition and managed care have on hospitals' pricing behavior. I use data from acute care hospitals in Florida to seek answers to three key questions. First, does the pricing behavior of nonprofit hospitals differ systematically from that of for-profit hospitals? Second, does increased competition elicit different pricing responses from for-profit and nonprofit hospitals? And finally, does an increase in the influence of managed care organizations intensify price competition between hospitals?

Some health care economists have argued that the goals of nonprofit hospitals include objectives such as enhancing their own prestige and providing care to a large number of patients, and so differ from the profit maximizing objective of for-profit hospitals (Newhouse (1970) and Dranove (1988)). Dranove (1988) incorporates different objective functions for for-profit and nonprofit hospitals and provides an elegant framework for analyzing the behavior of hospitals with different ownership structures.[1] I extend Dranove's model to examine how for-profit and nonprofit hospitals' pricing behavior change as competitive forces strengthen. The impact of competition on hospital prices has been a matter of considerable interest and debate. Some researchers have argued that competition among hospitals takes the form of a "medical arms race" where hospitals compete to attract physicians and patients by over-investing in medical technology. Indeed some antitrust courts have permitted hospital mergers on the grounds that they would curtail the medical arms race (Dranove and White (1994)). Lynk (1995) argues that since nonprofit hospitals have different objectives than the for-profit firms typically analyzed by economists the microeconomic paradigm that more competitive markets lead to lower prices does not necessarily apply to hospital markets. He argues that nonprofit hospitals should not be judged on the basis of antitrust standards designed for for-profit firms. He finds that nonprofit, non-federal hospitals in California raise prices when their markets become more competitive, while for-profit hospitals lower prices when their markets become more competitive. The results obtained in this paper suggest that nonprofit hospitals in Florida respond differently to competition than for-profit hospitals. I find that prices at nonprofit hospitals increase while prices at for-profit hospitals decrease as markets become more competitive.

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[1] Dranove (1988) finds evidence of cost-shifting behavior among nonprofit hospitals. His data do not allow him to compare the pricing behavior of for-profit and nonprofit hospitals.

Perhaps the most dramatic component of recent changes in the health care industry is the rapid increase in the importance of managed care. Organizations such as health maintenance organizations (HMOs) and preferred provider organizations (PPOs) obtain discounts from hospitals in return for directing their enrollees to the hospitals. Dranove, Shanley, and White (1993) argue that the emergence of managed care organizations has altered the way in which health care providers compete for patients. While hospitals previously competed for well-insured and relatively ill-informed individual customers who were insensitive to price changes, they now have to attract managed care organizations that have strong incentives to contain health care expenditure. Dranove, Shanley and White (1993) posit that as managed care becomes increasingly important, the effects of competition on hospital prices will increasingly conform with the traditional microeconomic model.[2] I find that the impact that increased competition has on hospital prices indeed depends on the importance of managed care to the hospitals in question. I find that hospital prices in Florida generally increase with competition. However, prices at hospitals that draw a large fraction of their patients from HMOs and PPOs either decrease or are not significantly affected when their markets become more competitive. I also find evidence that the prices hospitals charge patients with different types of insurance are affected differently as managed care becomes more influential. I find that hospitals that draw more than 20% of their patients from HMOs and PPOs raise prices for self-pay/indemnity patients when their market share increases. These hospitals lower prices for HMO patients when their market share increases. This suggests that when powerful managed care companies extract large discounts from dominant hospitals, the hospitals may respond by raising prices for patients who have less negotiating power.

The remainder of this paper is organized as follows. In the next section, I examine the factors that may affect hospital prices. Then I describe the data and discuss the empirical issues that arise in the analysis presented here. After that I present the key results of this paper. The final section presents the conclusions of this analysis and suggests directions for future research.

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[2] Their data does not allow them to determine managed care penetration rates, so they are unable to test this hypothesis.

Factors that affect Hospital Prices

Following Dranove (1988), suppose a nonprofit hospital seeks to maximize an objective function that includes profit and output. The hospital may value higher output for altruistic reasons -- to increase access to health care, for example. The hospital may also value higher output because higher output adds to the hospital's prestige, or because higher output is beneficial to influential constituencies (such as staff physicians) within the hospital. Suppose the demand for the hospital's services, $Q(P)$, decreases with the price, P, charged by the hospital. The hospital's cost of treating Q patients is $C(Q)$. The hospital chooses price to maximize its utility function

$$U = U(PQ(P) - C(Q(P)), Q(P)) \tag{14}$$

Since the hospital values both profit and output, its utility increases with both profit and output, so $U_1 > 0$, $U_2 > 0$, where subscript i denotes a derivative with respect to the ith argument.[3] Assume that both U and hospital profit are concave in the price charged by the hospital. A necessary condition for the hospital to maximize its utility is

$$U_1[Q(P) + PQ'(P) - C'(Q(P))Q'(P)] + U_2 Q'(P) = 0 \tag{15}$$

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[3] Notice that the nonprofit hospital will always make positive profit in this formulation if the hospital's valuation of additional profit becomes very large as profit becomes very small. That is, the constraint that the hospital makes at least zero profit will not bind if $U_1 \to \infty$ as $[PQ(P) - C(Q(P))] \to 0$.

$U_2 = 0$ for a profit maximizing hospital. So equation (15) implies that a for-profit hospital will charge a higher price than a comparable nonprofit hospital (Dranove (1988)).

Equation (15) can be rearranged to yield

$$P = \left[C'(Q(P)) - \frac{U_2}{U_1} \right] \left[\frac{1}{1 - 1/\varepsilon} \right], \tag{16}$$

where $\varepsilon = -Q'(P)P/Q(P)$ is the price elasticity of the hospital's demand. $U_2 = 0$ for a profit maximizing hospital, so the price charged by a for-profit hospital is

$$P = \left[C'(Q(P)) \right] \left[\frac{1}{1 - 1/\varepsilon} \right] \tag{17}$$

Equations (16) and (17) suggest that the medical arms race view of hospital competition is most likely to be valid if competition does not render hospital demand more price elastic, and increased competition among hospitals leads to greater investment in high-tech medicine that increases the marginal cost of treatment.[4] More competition leads to lower hospital prices if it does not increase marginal costs and if it makes hospital demand more price elastic.

Notice that the differences in the pricing behavior of for-profit and nonprofit hospitals arise due to the fact that nonprofit hospitals value output for its own sake, while for-profit hospitals do not (that is $U_2 > 0$ for nonprofit hospitals while $U_2 = 0$ for for-profit hospitals). Nonprofit hospitals will lower (raise) prices in response to increased competition when for-profit hospitals raise (lower) prices only if increased competition changes, either directly or indirectly, nonprofit hospitals' relative valuations of additional profit and additional output (that is, if increased competition changes U_2/U_1). It is difficult to place *a priori* restrictions on how increased competition will alter nonprofit hospitals' relative valuations of additional profit and additional output. If increased competition, particularly from for-profit hospitals that have an incentive to target the most profitable patients, reduces nonprofit hospitals' ability to finance their operations, then it may increase their valuation of additional profit. Alternately, increased competition may increase nonprofit hospitals' valuation of additional output. Consider a nonprofit hospital that values higher output because higher output enables it to increase access to health care. If increased competition for the most profitable patients reduces some less profitable patients' access to treatment, then such a nonprofit hospital's valuation of additional output may increase with greater competition.

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[4] It is unclear whether greater investment in high tech medicine will lead to higher marginal costs rather than to higher fixed costs. However, Friedman and Pauly (1981) find that medium- and long-run hospital marginal costs are roughly 98% of long-run average total costs. If technology enhancing staff and equipment account for a large portion of hospital average total costs, then this suggests that greater investment in high-tech medicine will increase hospital marginal costs over the medium- and long-run planning horizon, if not in the short-run.

I find that prices charged by nonprofit hospitals increase while the prices charged by for-profit hospitals decrease as competition increases. This suggests that if increased competition makes hospital demand more price elastic, it may also increase nonprofit hospitals' valuation of additional profit relative to their valuation of additional output.

The price that a hospital charges may be affected by the type of patients it serves. Dranove, Shanley, and White (1993) argue that as managed care penetration increases hospital markets experience a change from "patient-driven" competition to "payer driven" competition. Under patient-driven competition, hospitals compete to attract physicians and their well-insured patients who are not price sensitive. Under payer-driven competition, hospitals have to attract organizations that shop on behalf of thousands of patients and have very strong incentives to contain health care expenditure. If managed care organizations provide a large percentage of a hospital's patients, they may be able to negotiate lower prices with the hospital by threatening to cut the hospital off from a large portion of its market. The bargaining strength of managed care organizations' vis-à-vis the hospital may also depend on the amount of competition among managed care organizations. A single HMO or PPO that controls a large fraction of a hospital's potential patient base will be in a better negotiating position than one of a number of managed care organizations that jointly control a large fraction of the hospital's potential patient base.[5] The hospital's negotiating position improves if it faces little competition or is a major player in the market, so its services are crucial to the ability of managed care organizations to attract enrollees. A high occupancy rate at the hospital may also lead to higher prices since higher occupancy rates decrease the need to attract additional patients with lower prices. Other factors that may lead to higher prices include the hospital's reputation for high quality treatment, and characteristics of its patient population that render treatment more costly.

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[5] The data available for this study do not allow me to examine the amount of market concentration in the HMO/PPO market.

Empirical Issues and the Data

This paper examines the pricing behavior of hospitals. However, measuring hospital prices is difficult. In many previous economic studies researchers have used list prices posted by hospitals.[6] However, list prices overstate the amount of money a hospital receives because managed care organizations typically negotiate significant discounts from list prices. Some recent research has recognized this problem and has attempted to correct for it. Dranove (1988) defines price for private payers (all payers except Medicare and Medicaid) as inpatient revenues from private payers divided by the number of private admissions. Dranove, Shanley and White (1993) calculate net prices for a market basket of hospital services from information on gross revenue (revenue hospitals would receive if list prices were paid), net revenue (revenue hospitals actually receive), and the number of units of service provided. Lynk (1995) uses list prices as well as net prices calculated from information on hospitals' gross and net revenues from all non-Medicare/Medicaid patients.

The source of my hospital price data is the *1996 Guide to Hospitals in Florida* published by Florida's Agency for Health Care Administration (AHCA) that lists average charges billed by two hundred and two acute care hospitals in Florida for fifteen service lines.[7] Hospital charges are the sum of the list prices of all hospital services provided to a patient during a hospital stay. AHCA reports average charges that have been adjusted for variation across the state in the cost of goods and services that hospitals purchase The adjustments were made using the county-specific Florida Hospital Input Price Index Since hospitals often are not paid the charges they bill on the basis of list prices I do not use charges to represent the prices hospitals can expect to receive from all patients Instead, I use information on hospital charges, and on hospitals gross and net revenues to compute the price that they can expect to receive from different types of payers

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[6] See Noether (1988), for example.

[7] The *1996 Guide to Hospitals in Florida* is based on 1994 data. According to AHCA, the data that is used to compile the *1996 Guide to Hospitals in Florida* is "widely regarded as among the best in the nation." The chief executive officers and the chief financial officers of hospitals must attest to the accuracy of the data submitted to AHCA. AHCA reviews the data for consistency, carries out extensive edit checks, and asks hospitals to confirm or correct any suspicious data.

Patients are classified into service lines on the basis of their All Patient Refined Diagnosis Related Groups (APR DRGs)[8] Medicare has defined approximately 470 Diagnosis Related Groups (DRGs) that require similar resource use in a hospital The APR-DRG classification system is a refinement that incorporates information on both the types of patients a hospital serves (case mix) and the severity of individual patients sickness The APR-DRG classification system provides about three times as many categories as Medicare DRGs.

AHCA excludes certain types of patients from its calculations of hospital average charges. Due to inconsistencies in the way hospital charges are reported for normal newborns, normal newborns are excluded[9] AHCA excludes patients who are transferred out to another acute care hospital patients who leave against medical advice and patients who are transferred in from another acute care hospitals and die within the first two days. Also excluded are "outliers" with extreme charges or lengths-of-stay (LOS). A patient is defined as an outlier if charges or LOS are either less than the low cutoff or greater than the high cutoff for her APR-DRG. AHCA established cutoffs by first finding "adjusted" charges and LOS for patients in the 75th and 25th percentiles of the statewide distribution of charges and LOS for their APR-DRG.[10] The difference between the values for patients in the 75th and 25th percentiles is known as the interquartile range. The high cutoff was then obtained by multiplying the interquartile range by 2.5 and adding the product to charges (or LOS) for patients in the 75th percentile. The low cutoff was obtained by multiplying the interquartile range by 1.5 and subtracting the product from charges (or LOS) for patients in the 25th percentile. Finally, AHCA excludes a small number of patients whose charges are so high or so low that the accuracy of the data is suspect. The cutoffs used for these patients were charges less than $150 per day or greater than $50,000 per day.

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[8] The service lines listed by the AHCA are cardiac surgery cardiology gastroenterology general surgery gynecology neonatology neurology neurosurgery obstetrics, oncology orthopedics, "other" medicine pediatrics pulmonary medicine and urology

[9] The newborn s charges are sometimes added to the mother s account. In other cases the newborn s charges are reported on a separate account

I also obtain information on hospitals' ownership (whether the hospital is private for profit, private nonprofit, or government owned) and the number of admissions at each hospital to each service line from the AHCA data set. I combine this with hospital financial data from the Florida Hospital Association (FHA). FHA also provides information on the number of patients in different payer classes treated by the hospitals. Finally, I obtain county level demographic information from the *City and County Sourcebook* (1994) published by the U.S. Department of Commerce, Bureau of the Census.

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[10] The adjustments are made in order to account for patient risk factors. For more information on the techniques used, see the *1996 Guide to Hospitals in Florida*.

Patients with indemnity insurance and "self-pay" patients (patients who pay their own bills in full) pay the hospital's list price for treatment, so prices for these patients are simply the charges billed by the hospitals. To calculate the price the hospital receives from HMO patients, I use FHA data on each hospital's gross and net revenues from HMOs to first calculate the fraction of billed charges that HMOs actually pay.[11] This fraction is then multiplied by the charges billed. The price that the hospital receives from PPOs is calculated similarly.

The empirical analysis is carried out on a data set that includes prices the hospital receives from indemnity or self-pay patients, from HMO patients, and from PPO patients. Not all hospitals listed in the AHCA data set are included in the FHA data set, so no managed care penetration data is available for these hospitals and they are not included in the price regressions. However, information from them is included in calculations of market level variables. In all, managed care and price information was available from 85 nonprofit, 61 for-profit, and 22 local/state (non-federal) government hospitals.

Managed care penetration is defined as the percentage of a hospital's patients that are insured by HMOs or PPOs. Managed care penetration rates at hospitals in the sample range from zero to 48.6%. Almost 40% of the hospitals in the sample have managed care penetration rates below 10%. The median managed care penetration rate is 13%. Approximately 20% of the hospitals have managed care penetration rates higher than 25%, and approximately 10% of the hospitals have managed care penetration rates higher than 30%.

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[11] Gross revenue is the revenue the hospital would obtain if all billed charges were paid. Net revenue is the revenue the hospital receives after taking account of discounts provided to payers.

I treat each hospital's county as its relevant market. Hospitals in a single county that provide treatment in a service line are regarded as competitors in that service line and their market shares are used to calculate the Herfindahl index.[12,13] The Herfindahl index (*herf*) is the sum of the squared percentage market shares of all firms in a market. Thus, a market served by a single firm has a Herfindahl Index of 10 000 (100^2), a market with two firms that share the market equally has a Herfindahl Index of 5 000 ($50^2 + 50^2$), and a two-firm market where one firm has an 80 percent market share has a Herfindahl Index of 6 800 ($80^2 + 20^2$). The Herfindahl Index is used to measure the competitiveness of a market -- the lower the index, the greater the amount of competition in a market. The use of service lines in defining hospital markets addresses the concern that using general acute care services to define a market leads to extreme aggregation (Zwanziger et al 1994).[14] Table 3 summarizes the values of the Herfindahl Index in different service lines.

Some health care economists have argued that for-profit hospitals compete differently than nonprofit hospitals. For-profit hospitals may aggressively seek out the most profitable patients, for example. They may also provide less charity care and may avoid patients whose treatment costs exceed the revenue the

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[12] Numerous previous economic studies have treated the county as the relevant geographical market. See Lynk (1995), for example. Lynk points out that counties approximate the territorial units that antitrust authorities argue are markets in antitrust litigation. So, at a minimum, the results obtained here are informative in evaluating the merits of such litigation.

[13] The market measures used in this study are service line specific. Most previous studies have used hospitals' total beds or admissions in calculations of market measures.

[14] Zwanziger *et al* advocate the use of patient origin data to define the geographical extent of a hospital's market. Patient origin data is not available for this study.

hospitals obtain from them. *cprofit* is included in the regressions to control for these possible differences. For each hospital providing treatment in a service line *cprofit* is the percentage of admissions in the service line at all other hospitals in the county that are at for-profit hospitals. Thus *cprofit* measures the percentage of a hospital's competition that is from for-profit hospitals. In addition to depending on the overall competitiveness of the market, the prices a hospital charges may depend on whether the hospital is a dominant player in the market. *mktshare* is the hospital's market share stated as a percentage. It reflects how a hospital's pricing behavior may depend on its relative importance in its market.

I estimate linear regressions that control for the service line in which treatment is provided and for fixed effects that may be associated with individual hospitals. Hospital specific fixed effects may arise from hospitals' reputations for quality, from the ability of their management, or from factors that change their cost of providing treatment. Controlling for hospital specific fixed effects precludes identification of variables that do not vary within hospitals. Notice that *herf*, *mktshare*, and *cprofit* are defined for individual service lines, and so vary within as well as across hospitals. A dummy variable is included in the price equation for hospitals that specialize in particular service lines.[15]

Since a hospital's market share and the type of competition it faces may be affected by the prices it charges, *mktshare* and *cprofit* are estimated using instrumental variables in order to avoid potential endogeneity problems. Predicted values of these variables are then used to estimate prices in a two-stage least squares procedure The variables used as instruments for *mktshare* and *cprofit* include information on educational attainment, income levels, and the racial composition of the people in the counties in which the hospitals are located The percentage of the over twenty-five population that has high school and/or college degrees is used to measure educational attainment Income levels are measured by the median income, by the percentage of the population that is classified as poor, the percentage of the elderly population that is classified as poor, and by the percentage of people that fall into different income groups Racial composition is measured by the percentage of the population that is classified as African American Hispanic Native American and Asian Other demographic variables that are used as instruments include the population of the county, the number of males per one hundred females the average number of persons in a household the percentage of one person households and the percentage of population that is elderly Some variables that reflect the general health status of the population are also included as instruments These include the birthrate per thousand residents the rate of infant mortality per thousand the number of community hospital beds per 100 000 residents and the number of active, non federal physicians per 100 000 residents

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[15] I define a hospital to be specialized in a service line if the service line accounts for more than 30% of admissions at that hospital.

Results

The key empirical objective of this paper is to examine the pricing behavior of hospitals with different ownership structures and the impact that competition and managed care have on hospitals pricing behavior

Tables 6 through 11 list the results of regressions estimating the price that hospitals will charge. The first regression in each table shows how hospitals in markets with minimal managed care (*adman* is percentage of hospital admissions from managed care) influence respond to decreased competition (*herf*), increased hospital market share (*mktshare*), and increased competition from for profit hospitals (*cprofit*). Regressions 2 to 7 show how pricing behavior changes when observations from hospitals with higher managed care penetration rates are successively included. In each table, regression 8 lists results for all observations in the class being considered in that table. Regressions numbered 9 to 15 show how pricing behavior changes when observations from hospitals with the least managed care influence are successively eliminated. Thus, regression numbers 1 to 15 in each table show how pricing behavior changes as managed care becomes successively more influential.

Tables 6 to 8 report results of regressions that pool price information for different types of payers. The regressions reported in these tables include dummy variables to examine how prices for HMO and PPO patients differ from prices for self-pay/indemnity patients who pay list prices. Tables 9, 10, and 11 report results of regressions that examine how prices for self-pay/indemnity, HMO and PPO patients are affected by competition and managed care. Table 12 lists detailed results of the regression examining how overall hospital prices in Florida change with competition. The results presented in Table 12 are summarized in row 8 of Table 6.[16]

The results in Table 6 show that overall hospital prices (see row 8) decline as *herf* increases, so prices increase with competition as measured by the Herfindahl index. However, in sub-samples of hospitals with greater than 20% managed care penetration prices either increase or are not significantly affected as *herf* increases. These findings are consistent with the hypothesis posited by Dranove, Shanley and White (1993) that hospital markets with patient-driven competition are more likely to see medical arms race type competition that leads to higher prices while markets with payer-driven competition are more likely to see lower prices. While *herf* measures competition in the market as a whole, *mktshare* is a measure of a hospital's position in the market. Notice (also in Table 6) that hospitals with larger market shares charge higher prices. This result is largely unaffected by changes in the influence of managed care.

To interpret these results consider a situation where hospitals A, B, and C are all located in the same county. Assume that in one service line, hospitals A and B treat 40% of the patients each while hospital C treats the remaining 20%. The Herfindahl Index in this market is 3,600 ($40^2 + 40^2 + 20^2$). Suppose that a fourth hospital, hospital D, now enters the market and begins providing treatment to 10% of the patients in the service line. Assume that the market share of hospitals B and C remains unchanged when hospital D enters the market. The market share of hospital A decreases to 30%. The new Herfindahl Index in the market is 3,000 ($30^2 + 40^2 + 20^2 + 10^2$). The regression results reported in row 8 of Table 6 suggest that prices at hospitals B and C will increase by $108 ((-600)*(-0.18)=108), while prices at hospital A will decrease by $1,252 ((-600)*(-0.18)+(-10)*136=1252).

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[16] Table 12 reports regression results for dummy variables denoting different service lines. The dummy variable denoting Cardiac Surgery was omitted from all regressions, so Cardiac Surgery is the default service line for the regressions reported in this paper.

The results presented in Tables 7 and 8 show how the prices charged by for-profit and nonprofit hospitals change with competition and managed care. Notice (in row 8 of either table) that prices at for profit hospitals increase while those at nonprofit hospitals decrease with *herf*. This result suggests that increased competition increases nonprofit hospitals' valuation of additional profit relative to their valuation of additional output. As mentioned earlier, competition may cause nonprofit hospitals' valuation of additional profit to increase, if increased competition reduces their ability to finance their operations.

Tables 9, 10, and 11 report how the prices that hospitals charge self-pay/indemnity, HMO and PPO patients are affected by increasing competition and managed care influence. A comparison of the results presented in tables 9 and 10 shows how increased managed care influence may affect the prices hospitals charge patients with different types of health coverage. Notice that in subsets of hospitals with more than 20% managed care penetration, prices for self-pay/indemnity patients increase while prices for HMO patients decrease when *mktshare* increases. This suggests that when influential HMOs extract greater discounts from dominant hospitals, the hospitals may respond by increasing the prices they charge self pay/indemnity patients. This finding is consistent with cost shifting behavior of the type described by Dranove (1988).

Conclusion

This paper presents an analysis of the pricing behavior of acute care hospitals. I extend Dranove's (1988) model to examine how for-profit and nonprofit hospitals' prices will change in response to increased competition in their markets. I find that for-profit and nonprofit hospitals do react differently to increased competition. Prices charged by nonprofit hospitals increase as their markets become more competitive while the prices charged by for-profit hospitals decrease as their markets become more competitive.

Managed care has an important impact on the manner in which hospitals compete with each other. I find that overall hospital prices increase as hospital markets become more competitive. However, at hospitals that draw a large portion of their patients from HMOs and PPOs, prices either decrease or are not significantly affected as markets become more competitive. These findings are consistent with Dranove, Shanley, and White's (1993) hypothesis that hospital markets where payers (such as managed care companies) play an important role experience greater price competition than markets where hospitals are chosen mainly by physicians and their price-insensitive patients.

In addition to its effect on how hospitals compete with each other, increased managed care influence may also affect the prices hospitals charge patients with different types of insurance coverage. I find that hospitals that serve a large fraction of managed care patients lower prices for HMO patients and raise prices for self-pay/indemnity insurance patients when their market share increases. This suggests that dominant hospitals may respond to pressures for discounts from powerful HMOs by raising prices for other patients.

This paper provides some insight on how hospital prices are affected by managed care and by greater competition. However, further research is needed to examine additional aspects of competition among hospitals and how managed care changes the manner in which hospitals compete with each other The analysis in this paper makes a number of simplifying assumptions This paper assumes that hospital specific effects take the form of fixed effects. In this paper calculations of the prices that hospitals can expect to receive from HMOs are based on the assumption that all HMOs pay the same fraction of billed charges for every service line Calculations of prices paid by PPOs are based on a similar simplifying assumption The exclusion of outliers in AHCA's calculations of hospital average charges may be problematic if patients with high or low charges are systematically excluded from hospitals with particular market characteristics Future research using better data sets is needed to address additional issues and to allow simplifying assumptions to be relaxed.

Table 3.

Summary Statistics—Herfindahl Index

	Mean	Std. Dev	Min	Max
Cardiac Sur	4535.848	2571.596	1800.824	10000
Cardiology	3220.354	2747.793	631.6893	10000
Gastroenterology	2989.707	2693.346	630.8969	10000
General Surgery	2907.354	2482.396	720.6915	10000
Gynecology	3110.014	2537.028	887.473	10000
Neonatology	4286.734	2739.026	1869.217	10000
Neurology	2765.402	2430.821	583.6151	10000
Neurosurgery	3957.485	2592.141	2096.372	10000
Obstetrics	4277.175	2848.857	1453.9	10000
Oncology	2954.054	2363.853	886.4409	10000
Orthopedics	2815.583	2324.426	691.5604	10000
Other Medicine	3117.2	2872.054	591.966	10000
Pediatrics	4709.921	2721.882	1724.394	10000
Pulmonary Med	3233.473	3002.849	523.7963	10000
Urology	2711.531	2356.979	682.9436	10000

Table 4.

Summary Statistics—Prices for Insurance/Self-Pay Patients

	Mean	Std. Dev	Min	Max
Cardiac Sur	53707.84	9801.997	35700	79800
Cardiology	9748.333	2213.354	3200	17300
Gastroenterology	8677.528	1413.834	5300	12000
General Sur	21910.4	4603.324	6900	30600
Gynecology	9574.419	1944.354	4500	17900
Neonatology	9191.139	9677.666	1200	54300
Neurology	9979.141	7178.108	5500	99000
Neurosurgery	33945.45	5404.88	23900	42200
Obstetrics	4428.571	857.6554	2700	7200
Oncology	12978.63	2585.531	7200	20100
Orthopedics	15761.45	2867.026	6100	23600
Other Medicine	8985.246	1817.362	4300	16300
Pediatrics	5939.806	2281.999	2900	14500
Pulmonary Med	12586.17	2673.302	5600	18400
Urology	11996.24	2512.707	6300	19000

Table 5

Summary Statistics—Prices for HMO and PPO Patients

	Prices for HMO Patients		Prices for PPO patients	
	Mean	Std Dev	Mean	Std Dev
Cardiac Sur	26698.45	9435.154	30068.36	8489.573
Cardiology	4803.401	1801.915	5497.598	2116.805
Gastroenterology	4301.332	1493.316	4811.783	1707.884
General Sur	10880.59	4141.891	12217.81	4438.815
Gynecology	4723.057	1887.693	5292.319	2082.237
Neonatology	6160.955	7980.898	6048.052	8175.973
Neurology	4896.728	3518.988	5542.753	4731.787
Neurosurgery	19196.63	3951.825	20968.94	2850.307
Obstetrics	2265.711	809.8672	2488.543	789.8336
Oncology	6567.499	2524.328	7413.138	2962.563
Orthopedics	7914.419	2893.056	8826.31	3389.487
Other Medicine	4480.664	1642.455	5047.746	2005.458
Pediatrics	3428.882	2033.297	3773.792	1990.332
Pulmonary Med	6323.537	2250.918	7034.587	2597.456
Urology	5920.978	2483.585	6919.12	2739.215

Table 6

Regression results for all Hospitals

	Hospitals are included in regression	Coef for *herf*	Coef For *mktshare*	Coef For *cprofit*	Coef for *HMO* dummy	Coef for *PPO* dummy	# of observations
1	if *admsn*<10	-0.017 (0.122)	17.3 (45.1)	121 (126)	-4771*** (243)	-4918*** (203)	1250
2	if *admsn*<15	-0.059 (0.097)	25.3 (48.1)	73.9 (124)	-5506*** (186)	-5202*** (169)	2092
3	if *admsn*<20	-0.22** (0.087)	145*** (28.8)	37.5 (23.8)	-5856*** (180)	5197*** (170)	2931
4	if *admsn*<25	-0.19** (0.085)	126*** (26.6)	27.8 (22.9)	-6064*** (169)	5328*** (161)	3150
5	if *admsn*<30	-0.20** (0.078)	137*** (26.3)	31.9 (22.7)	-6076*** (153)	5337*** (146)	3715
6	if *admsn*<35	-0.18** (0.078)	141*** (26.4)	31.5 (22.7)	-6176*** (147)	-5473*** (143)	4004
7	if *admsn*<40	-0.18** (0.078)	139*** (26.5)	34.9 (22.9)	-6150*** (144.7)	5485*** (141.8)	4126
8	Unconditionally	-0.18** (0.077)	136*** (26.1)	35 (22.7)	-6167*** (140)	-5482*** (138)	4300
9	if *admsn*>10	-0.18* (0.09)	174*** (30.7)	52.1** (24.4)	-6606*** (166.3)	5740*** (171.8)	3050
10	if *admsn*>15	-0.29** (0.117)	174*** (31.8)	55.9** (25.1)	-6676*** (198)	5770*** (210.7)	2208
11	if *admsn*>20	0.06 (0.18)	140** (68.3)	77.5 (138)	-6718*** (211)	-6089*** (227)	1469
12	if *admsn*>25	0.02 (0.21)	710*** (113.9)	800*** (43)	-6436*** (234)	5940*** (253)	1158
13	if *admsn*>30	1.30* (0.77)	575*** (148.2)	826*** (50.6)	-6659*** (339)	-6654*** (418)	585
14	if *admsn*>35	1.00 (0.87)	329** (152.1)	920*** (53.4)	-6074*** (410)	5664*** (513)	296
15	if *admsn*>40	0.53 (0.88)	566*** (166.9)	983*** (53.5)	-6545*** (492)	5266*** (605)	174

Standard Errors are listed in parentheses
* significant at 10% level ** significant at 5% level *** significant at 1% level

Table 7.

Regression Results for For-Profit Hospitals

	Hospitals are included in regression	Coef for *herf*	Coef for *mktshare*	Coef for *cprofit*	Coef for *HMO* dummy	Coef for *PPO* dummy	# of observations
1	if *admnum*<10	0.13 (0.25)	23.1 (43.3)	185.9 (236)	-4944*** (362.5)	-5938*** (325.0)	391
2	if *admnum*<15	0.35 (0.24)	48.5 (51.6)	126.8 (234)	-5973*** (328)	-7066*** (307)	670
3	if *admnum*<20	0.28 (0.28)	42.4 (42.6)	111.8 (141)	-6334*** (306)	-6950*** (277)	818
4	if *admnum*<25	0.28 (0.19)	25.0 (32.9)	72.7 (104)	-6860*** (288)	-6993*** (285)	1017
5	if *admnum*<30	0.42*** (0.16)	24.4 (31.9)	79.8 (101)	-6761*** (258)	-6839*** (239)	1167
6	if *admnum*<35	0.44*** (0.17)	24 (32.9)	2.8 (101.8)	-6910*** (243)	-7103*** (238)	1295
7	if *admnum*<40	0.44*** (0.16)	24.3 (32.6)	4.3 (101)	-6794*** (231)	-7081*** (232)	1372
8	Unconditionally	0.44*** (0.18)	27.2 (32)	33.1 (97)	-6812*** (222)	-7075*** (225)	1440
9	if *admnum*>10	0.57*** (0.21)	21.2 (44.7)	27.4 (119.6)	-7388*** (228.3)	-7569*** (279.5)	1049
10	if *admnum*>15	0.47** (0.24)	16.2 (44.1)	12.3 (120.1)	-7389*** (301)	-7107*** (326)	764
11	if *admnum*>20	0.57** (0.29)	116 (84.8)	171 (189.2)	-7268*** (324)	-7267*** (375)	622
12	if *admnum*>25	0.85* (.038)	1399*** (215.2)	1343*** (50.1)	-6695*** (360)	-7257*** (422)	423
13	if *admnum*>30	3.24 (2.07)	1248*** (243.3)	1175*** (177)	-6962*** (476.3)	-8503*** (631.3)	273
14	if *admnum*>35	2.95 (1.95)	20.92 (207.4)	321*** (48.9)	-6154*** (436.8)	-6978*** (640.3)	145
15	if *admnum*>40	-0.5 (3.15)	50.8 (215)	385*** (66.7)	-7417*** (690.1)	-6533*** (921)	68

Standard Errors are listed in parentheses

* significant at 10% level, ** significant at 5% level, *** significant at 1% level

Table 8.

Regression Results for Nonprofit Hospitals

	Hospitals are included in regression	Coef for *herf*	Coef for *mktshare*	Coef For *cprofit*	Coef for *HMO* dummy	Coef for *PPO* dummy	# of observations
1	if *admsn*<10	0.08 (0.14)	1310 (870.5)	1287 (883.5)	-4739*** (287.3)	-4524*** (246.2)	715
2	if *admsn*<15	-0.14 (0.11)	1390 (898)	1284 (911)	5275*** (228.3)	-4308*** (206.1)	1112
3	if *admsn*<20	-0.36*** (0.86)	17.2 (49.3)	7.35 (23.8)	-5601*** (193)	-4389*** (186)	1499
4	if *admsn*<25	-0.37*** (0.84)	15.9 (48.4)	7.5 (23.4)	5646*** (183)	-4470*** (178)	1619
5	if *admsn*<30	-0.41*** (0.08)	31.1 (52.9)	1.8 (24.7)	-5758*** (171)	-4628*** (185)	2034
6	if *admsn*<35	-0.39*** (0.08)	32.7 (51)	-0.08 (24.7)	-5831*** (164.3)	-4697*** (160.6)	2195
7	if *admsn*<40	-0.37*** (0.084)	1.93 (51.5)	9.21 (25.1)	5825*** (185)	-4722*** (162)	2248
8	Unconditionally	-0.37*** (0.83)	1.15 (51.6)	0.98 (25.2)	5839*** (162.5)	-4744*** (160.4)	2312
9	if *admsn*>10	-0.39*** (0.10)	19.85 (53.2)	-0.58 (25.5)	6200*** (189.6)	-4850*** (197.5)	1598
10	if *admsn*>15	-0.45*** (0.12)	10.58 (52.9)	-0.46 (25.4)	6291*** (214.8)	-5188*** (228.1)	1201
11	if *admsn*>20	0.06 (0.21)	538*** (162)	842*** (58.2)	-6267*** (245)	5410*** (251)	814
12	if *admsn*>25	0.06 (0.22)	525*** (167)	834*** (60)	6277*** (271)	5410*** (281)	694
13	if *admsn*>30	0.99 (0.70)	707*** (291)	787*** (88.4)	6400*** (421)	5694*** (481)	279
14	if *admsn*>35	-0.05 (1.04)	802*** (263.5)	873*** (68.6)	-6104*** (574)	5707*** (661)	118
15	if *admsn*>40	-0.37 (1.6)	3342*** (332.5)	379*** (23.8)	-6216*** (869.7)	5656*** (1134)	73

Standard Errors are listed in parentheses
* significant at 10% level ** significant at 5% level *** significant at 1% level

Table 9

Prices Hospitals Charge Self-Pay/Indemnity Patients

	Hospitals are included in regression	Coef For *herf*	Coef For *mktshare*	Coef for *cyprofit*	# of observations
1	If *adman*<10	-0.013 (0.10)	20.3 (41.5)	35.1 (120)	586
2	if *adman*<15	-0.002 (0.12)	15.4 (40.7)	71 (118.0)	890
3	if *adman*<20	-0.27** (0.14)	10.1 (48.2)	-13.2 (45)	1166
4	if *adman*<25	-0.23* (0.13)	10.2 (39)	-15 (43.7)	1286
5	if *adman*<30	-0.27** (0.12)	9.3 (38.8)	-15.1 (43.4)	1491
6	If *adman*<35	-0.27** (0.12)	14.6 (38.2)	-15 (42.8)	1607
7	if *adman*<40	-0.27** (0.12)	15.4 (38.7)	-14.9 (43.4)	1655
8	unconditionally	-0.27** (0.12)	13.8 (38.2)	-14.2 (42.8)	1729
9	if *adman*>10	-0.31** (0.16)	6.1 (57.1)	-22.6 (52.7)	1103
10	If *adman*>15	-0.47** (0.21)	10.7 (83)	-20.4 (58)	839
11	if *adman*>20	0.06 (0.28)	920*** (166.6)	1051*** (61.0)	563
12	if *adman*>25	-0.18 (0.33)	915*** (171.7)	1052*** (64.4)	433
13	if *adman*>30	2.66** (1.08)	952*** (188.9)	1033*** (88.5)	238
14	if *adman*>35	0.79 (1.51)	608** (287.7)	1109*** (93)	122
15	if *adman*>40	0.012 (1.4)	830** (248.2)	1112*** (81.4)	74

Standard Errors are listed in parentheses
*significant at 10% level ** significant at 5% level
*** significant at 1% level

Table 10

Prices Hospitals Charge HMO Patients

	Hospitals are included in regression	Coef for *herf*	Coef for *mktshare*	Coef for *cprofit*	# of observations
1	if *admsn*<10	-0.11 (0.22)	2009*** (65.2)	-63.4*** (11.3)	284
2	if *admsn*<15	0.50*** (0.14)	1840*** (53.5)	2523*** (447.5)	530
3	if *admsn*<20	-0.45*** (0.11)	37.5 (57.1)	10.5 (20.9)	773
4	if *admsn*<25	-0.43*** (0.11)	38.5 (58)	11.0 (20.4)	873
5	if *admsn*<30	-0.38*** (0.1)	40.2 (55.1)	10.0 (20)	1054
6	if *admsn*<35	-0.38*** (0.09)	46.2 (53.7)	17.0 (25.3)	1157
7	if *admsn*<40	-0.35*** (0.1)	10.3 (54.5)	3.8 (25.8)	1205
8	unconditionally	-0.38*** (0.09)	14.8 (53.7)	2.8 (25.4)	1287
9	if *admsn*>10	-0.32*** (0.1)	7.9 (49)	9.2 (23.2)	983
10	if *admsn*>15	-0.27** (0.12)	22.4 (51.8)	8.8 (24.3)	737
11	if *admsn*>20	-0.21 (0.17)	1537*** (191.3)	1211*** (88.8)	404
12	if *admsn*>25	-0.28 (0.19)	1549*** (187)	1207*** (85.8)	384
13	if *admsn*>30	-0.81 (0.53)	2019*** (172)	1081*** (45)	213
14	if *admsn*>35	-0.54 (0.80)	1837*** (103.3)	1101*** (45.3)	118
15	if *admsn*>40	-0.23 (0.82)	2311*** (170.3)	258*** (14.7)	82

Standard Errors are listed in parentheses.

* significant at 10% level, ** significant at 5% level *** significant at 1% level

Table 11.

Prices Hospitals Charge PPO Patients

	Hospitals are included in regression	Coef For *herf*	Coef For *mktshare*	Coef For *cprofit*	# of observa-tions
1	if *admax*<10	-0.15 (0.15)	1819*** (50.8)	2711*** (224.2)	400
2	if *admax*<15	0.14 (0.11)	1717*** (40.6)	2521*** (220)	672
3	if *admax*<20	-0.03 (0.09)	420*** (30.5)	194*** (34.3)	862
4	if *admax*<25	-0.01 (0.09)	312*** (26.5)	99.8*** (31.6)	981
5	if *admax*<30	-0.04 (0.08)	337*** (26.5)	101*** (31.8)	1170
6	If *admax*<35	-0.02 (0.08)	334*** (26.1)	68.4*** (31.3)	1240
7	if *admax*<40	-0.03 (0.08)	342*** (25.8)	109*** (32.1)	1266
8	unconditionally	-0.03 (0.08)	336*** (26.6)	110*** (31.9)	1304
6	If *admax*>10	0.06 (0.18)	352*** (26.7)	114*** (32)	904
10	if *admax*>15	-0.21* (0.12)	350*** (26.7)	122*** (32)	632
11	If *admax*>20	-0.1 (0.18)	321*** (61)	202 (126.3)	412
12	if *admax*>25	0.02 (0.23)	871*** (135)	424*** (50.8)	323
13	If *admax*>30	0.25 (0.91)	322 (200)	555*** (62.4)	134
14	if *admax*>35	1.18 (1.54)	315 (277.8)	650*** (68.4)	64
15	if *admax*>40	-0.01 (1.42)	2437*** (312.1)	3560*** (576.6)	38

Standard Errors are listed in parentheses.
* significant at 10% level ** significant at 5% level
*** significant at 1% level

Table 12.

Detailed results of Price Regression for all Hospitals all Payers, and all Observations

```
  Source  |      SS         df       MS                 Number of obs =    4301
          |                                             F(185  4115)  =    90 5
   Model  |  1.945e+11     185  1.0517e+09              Prob > F      =  0.0000
Residual  |  5.3960e+10   4115  13116196 3              R squared     =  0.7849
          |                                             Adj R squared =  0.7748
   Total  |  2.4850e+11   4299  56742019 3              Root MSE      =  3621 4

   price  |      Coef     Std  Err        t    P>|t|      [95% Conf  Interval]

    year  |  -.1804021    .0771725   -2 338   0 019      .3217528    5291015
mk share  |  134 9375     24 14722    5 217   0 000     85 67447     188 2002
  profit  |  34 99172     22 49092    1 555   0 122     5 415550     79 35952
 special  |    60 81     702 0275   -2 072   0 002     2920 324      781 456
     HMO  |  -516  557    125 843   -44 055   0 000     4551 264      589 85
     PPO  |   940  894    120 2242  -25 447   0 000     9792 60     9211 952
cardiolo  |  30743 85     429 7596   72 210   0 000     21970 41     29909 18
gastroen  |  214 2 42     420 5941  -72 416   0 000     22564 55    -35780 55
 gen sur  |  -2 159 94    429 2491   52 147   0 000     22025 9     -21294 01
 gynecol  |  -21081 42    422 4860  -71 562   0 000     31555 75     35152 55
 nassets  |  -31000 7     444 4402   49 728   0 000     21000 45     20134 54
 neurolo  |  -30799 9     422 284   -71 252   0 000     31652 55     25555 14
neur sur  |  -13822 10    752 9260   18 298   0 000     19298 25     12256 03
obstetric |  -25238 01    527 0941  -95 232   0 000     35177 51      33459
oncology  |  28791 22     429 2883   49 942   0 000     29492 56     27930 01
orthoped  |  25452 21     424 0907  -42 5 2   0 000     27559 25      5515 14
other me  |  -21550 07    429 0191   72 192   0 000     22241 98     20959 7
pediatri  |  -23758 05    420 291   -78 513   0 000     35551 55    -22605 25
pulmonar  |  28487 54     420 7299   44 402   0 000     29932 43     27853 46
 urology  |  20262 28     420 455    45 955   0 005     302 2 9      29901 44
   _cons  |  42437 12     909 4491   47 140   0 000     41852 78     55613 55
```

CONCLUSION

Understanding the economics of the health care industry is difficult at the best of times. The current rapid pace of change in the industry places additional strains on our limited understanding of the subject. The three papers in this dissertation contribute to our understanding of some important issues in health care economics.

The first paper improves our understanding of the two most widely observed payment systems in the health care industry. It finds that while cost reimbursement for high-cost patients can eliminate dumping by health care providers, it also alters cost containment incentives from the ideal level. The paper shows that the optimal combination of prospective payment and cost reimbursement in a mixed payment system depends on how highly the payer values hospital profit. A payer who values hospital profit as highly as patient welfare is concerned solely with efficiency issues and will induce ideal cost containment by using (pure) prospective payment. However, when the payer has distributional concerns and values patient welfare more highly than hospital profit, she will use a mixed payment system to balance cost

The second paper furthers our understanding of the comparative advantages and disadvantages of the traditional indemnity system and the newer HMO system of health care delivery. I find that indemnity insurers make consumers bear part of the cost of their treatment directly through copayments and deductibles, and so do not provide their enrollees with full insurance. Hospitals treating patients with indemnity insurance compete aggressively for well insured patients by providing them with inefficiently high quality treatment. I find that HMOs fully insure their enrollees against the financial costs of treatment. The analysis in this paper also reveals important ambiguities about the health care market. The copayments high-risk consumers have to make may be higher or lower than those faced by low-risk consumers. I also find that the quality of treatment provided by HMOs may be higher or lower than the quality of treatment provided by hospitals serving patients with indemnity insurance.

An analysis of the pricing behavior of acute care hospitals is presented in the third paper in this dissertation. I find that overall hospital prices increase when hospital markets become more competitive. I also find that the influence of managed care organizations has an important impact on hospitals' pricing behavior. Prices at hospitals with high managed care penetration either decrease or are not significantly affected when markets are more competitive. I find that prices at for-profit hospitals decrease while those at nonprofit hospitals increase with competition.

While the research presented in this dissertation extends our understanding of important issues to health care economics, a number of key areas remain that require additional research attention. One important area of health care economics that remains inadequately studied is the issue of access to the health care system. The problem of ensuring access to health care is particularly important in view of legislative measures currently being considered that may adversely affect some individuals ability to obtain health care when they need it. I hope that health care economics research in the future will serve to inform this and other aspects of health care policy

APPENDIX A PAYMENT SYSTEMS – PROOFS

Proof of Lemma 1. The left-hand side of equation (2) can be integrated by parts to yield

$$\int_{\underline{c}}^{c^*} F_e(c;e^*)dc \tag{18}$$

Similarly, the left hand side of equation (3) reduces to

$$\int_{\underline{c}}^{p} F_e(c,e)dc \tag{19}$$

Since the marginal disutility of effort increases as effort increases, this implies that $e \neq e^*$ for all $p<c^H$ unless

$$\int_{p^*}^{c^H} F_e(c;e^*)dc = 0 \quad \blacksquare \tag{20}$$

Proof of Proposition 1. Under a mixed payment system, the hospital's marginal benefit of cost reduction effort is given by

$$c^* F_e(c^*,e) - \int_{\underline{c}}^{c^*} cf_e(c,e)dc. \tag{21}$$

A mixed payment system can induce first-best effort if there exists a c* such that

$$c^* F_e(c^*,e^*) - \int_{\underline{c}}^{c^*} cf_e(c,e^*)dc = -\int_{c^*}^{\bar{c}} cf_e(c;e^*)dc \tag{22}$$

Equation (22) can be rewritten as

$$c^* F_e(c^*, e^*) = -\int_{c^*}^{c} c f_e(c, e^*) dc \tag{23}$$

Thus, c* under a mixed payment system that can induce first best effort is given by

$$c^* = \frac{-\int_{c^*}^{c^H} c f_e(c, e^*) dc}{F_e(c^*, e^*)} \tag{24}$$

Integrating the numerator of equation (24) by parts provides

$$c^* = \frac{c^* F_e(c^*, e^*) - \int_{c^*}^{c} F_e(c, e^*) dc}{F_e(c^*, e^*)} \tag{25}$$

Under a mixed payment system $c^* < c^H$. Thus (25) implies that

$$c^* = c^H + \frac{\int_{c^*}^{c} F_e(c, e^*) dc}{F_e(c^*, e^*)} \neq c^*, \tag{26}$$

a contradiction, unless (20) is satisfied ■

Proof of Proposition 2: The derivative of the payer's problem with respect to p is given by

$$\begin{aligned} &\alpha\left(-F(p, e(p)) - pF_e(p, e(p))\frac{\partial e}{\partial p} - \int_{p}^{c^H} c f_e(c, e(p)) dc \frac{\partial e}{\partial p}\right) \\ &\quad + (1-\alpha)\left(F(p, e(p)) + pF_e(p, e(p))\frac{\partial e}{\partial p}\right. \\ &\qquad \left. - \int_{c^L}^{p} c f_e(c, e(p)) dc \frac{\partial e}{\partial p} - \psi'(e(p))\frac{\partial e}{\partial p}\right) \end{aligned} \tag{27}$$

Integrating (27) by parts and rearranging yields

$$\alpha(-F(p,e(p)) + \int_{p}^{c^H} F_e(c,e(p))dc\frac{\partial e}{\partial p}) + (1-\alpha)(F(p;e(p)) + \int_{c^L}^{p} F_e(c,e(p))dc\frac{\partial e}{\partial p} - \psi'(e(p)\frac{\partial e}{\partial p}) \tag{28}$$

Recall that the hospital chooses effort to maximize its profit. The hospital chooses *e(p)* such that

$$\int_{c^L}^{p} F_e(c;e(p))dc - \psi'(e(p)) = 0 \tag{29}$$

Since the marginal disutility of effort increases as effort increases equation (29) implies that effort is monotonic and increases as p increases for all $p \in (c^L\ c^H)$

Using equation (29), (28) reduces to

$$\alpha \int_{p}^{c^H} F_e(c;e(p))dc\frac{\partial e}{\partial p} + (1-2\alpha)F(p;e(p)) \tag{30}$$

When $\alpha = 1/2$, the first order condition in (30) becomes

$$\int_{p}^{c^H} F_e(c;e(p))dc\frac{\partial e}{\partial p} \tag{31}$$

(31) is strictly greater than zero for all $p<c^H$. Thus, when $\alpha = 1/2$, p is optimally set at c^H. When $p=c^L$ (30) is greater than 0 for all $\alpha \in [1/2\ 1]$. This implies that a mechanism under which all patients are paid for under cost reimbursement is never optimal. Similarly, (30) is less than 0 for all $\alpha \in (1/2,1]$ when $p=c^H$. This means that a system under which all patients are paid for prospectively is not optimal when the payer values patient welfare more highly than hospital profit. Thus, the payer will choose a mixed payment system when $\alpha \in (1/2,1]$

In general an increase in α places a greater weight on the second term in (30) which is less than zero For the necessary condition for maximization ((30)=0) to continue to be satisfied, the payer responds to an increase in α by decreasing ρ ■

APPENDIX B. MARKET STRUCTURE – PROOFS

Proof of Proposition 1. From equations (10) and (11)

$$\delta' = \frac{H'(s+q_A^{*})}{u'(y-T'-\delta' p_A^{*})} = \frac{H'(q_A^{n})}{u'(y-T'-\delta' p_A^{n})} \tag{32}$$

To see that $q_A^{*} > q_A^{n}$, suppose that $q_A^{n} \geq q_A^{*}$. Then, using the fact that at a symmetric equilibrium $d_A'^{*} = d_A'^{n} = 1/2$, that $s < 0$, and equations (8) and (9) $p_A'^{n} > p_A^{*}$. As will be shown in Proposition 3, $\delta' > 0$, so

$$u'(y-T'-\delta' p_A'^{n}) > u'(y-T'-\delta' p_A^{*}) \tag{33}$$

The assumption that $q_A'^{n} \geq q_A^{*}$ implies that

$$H'(s+q_A'^{*}) > H'(q_A'^{n}) \tag{34}$$

From (33) and (34)

$$\frac{H'(s+q_A^{*})}{u'(y-T'-\delta' p_A^{*})} > \frac{H'(q_A'^{n})}{u'(y-T'-\delta' p_A'^{n})} \tag{35}$$

(35) contradicts (32). Thus, $q_A^{*} > q_A'^{n}$.

To see that $p_A'^{*} > p_A^{n}$, suppose that $p_A'^{*} \leq p_A^{n}$. Then

$$u'(y-T'-\delta' p_A'^{*}) \leq u'(y-T'-\delta' p_A'^{n}) \tag{36}$$

From (32) this implies that

$$H'(s+q_A^{*}) \leq H'(q_A^{n}) \tag{37}$$

So $s+q_A^{s} \geq q_A^{\prime n}$ and $q_A^{s} > q_A^{n}$. Then, using the fact that at a symmetric equilibrium $d_A = d_A^{\prime n} = 1/2$, equations (8) and (9) imply that $p_A^{\prime} > p_A^{n}$, a contradiction. Thus, $p_A^{\prime} > p_A^{\prime n}$.

Note (from equations (8) and (9)) that, in equilibrium, the hospital makes a profit of $t/H'(s+q_A^{s})$ per severely sick patient and a profit of $t/H'(q_A^{n})$ per patient who is not severely sick. Since $p_A > p_A^{n}$, $u'(y-T'-\delta p_A^{s}) > u'(y-T'-\delta p_A^{n})$. So from equation (32), $H'(s+q_A^{n}) > H'(q_A^{n})$. Thus hospitals earn more profit per patient on patients who are not severely sick than on patients who are severely sick. ■

Proof of Propositon 2. Since $\delta < 1$, equations (10) and (11) imply that consumers' marginal utility of income exceeds the additional benefits they derive from higher quality treatment. This distortion, as measured by the ratio of consumers' marginal utility of income to their marginal utility of higher quality treatment, increases as δ decreases. ■

Proof of Lemma 1. When competing hospitals misreport severely sick patients severity of sickness, they provide patients treatment of quality $\bar{q}^{\,ls}$ at a symmetric equilibrium. $\bar{q}^{\,ls}$ is defined so that $p^{ln} = \dfrac{t}{H'(s+\bar{q}^{\,ls})} + \bar{q}^{\,ls}$.

Similarly, $\bar{q}^{\,ln}$ is the quality of treatment provided by the hospitals to a patient who is not severely sick when they misreport his severity of sickness. $\bar{q}^{\,ln}$ is defined so that $p^{is} = \frac{t}{H'(\tilde{q}^{in})} + \tilde{q}^{in}$. When a patient is provided treatment of quality q the hospital makes a profit of $t/H'(s+q)$ per severely sick patient and a profit of $t/H'(q)$ per patient who is not severely sick. It can be shown that $\tilde{q}^{is} < q^{is}$ and that $\tilde{q}^{in} > q^{in}$. Therefore, a hospital's profit decreases when it misreports the severity of a severely sick patient's illness. Its profit increases when it misreports the severity of sickness of a patient who is not severely sick. ■

Proof of Proposition 3. When insurance companies do not require copayments (that is when $\delta^{i} = 0$), $u(y - T^{i} - \delta^{i} p^{n}) = u(y - T^{i} - \delta^{i} p^{n})$ and $q^{n} < q^{s}$ so that (IC-N) is violated. ■

Proof of Proposition 4 The results in Proposition 4 follow from the data listed in Table 1. ■

Proof of Proposition 5 The first order necessary conditions with respect to HMO *A*'s choices of payments and treatment quality for severely sick patients can be expressed as equations (38) and (39), respectively

$$-\frac{u'(y - T_A^{s})}{2t}\{f^{s}[T_A^{s} - q_A^{s}] + (1 - f^{s})[T_A^{s*} - q_A^{s*}]\} + d_A = 0 \tag{38}$$

$$\frac{H'(s + q_A^{s})}{2t}\{f^{s}[T_A^{s} - q_A^{s}] + (1 - f^{s})[T_A^{s*} - q_A^{s*}]\} - d_A = 0 \tag{39}$$

Similarly, the first order necessary conditions with respect to HMO A's choices of payments and treatment quality for patients who are not severely sick can be expressed as equations (40) and (41), respectively

$$-\frac{u'(y-T_A^{n})}{2t}\{f\ [T_A^{s}-q_A^{s}]+(1-f\ )[T_A^{n}-q_A^{n}]\}+d'_A=0 \qquad (40)$$

$$\frac{H'(q_A^{n})}{2t}\{f\ [T_A^{s}-q_A^{s}]+(1-f\ )[T_A^{n}-q_A^{n}]\}-d_A=0 \qquad (41)$$

From equations (38), (39), (40), and (41),

$$H'(s+q_A^{s})=H'(q_A^{n})=u'(y-T_A^{s})=u'(y-T_A^{n}) \qquad (42)$$

From equation (42), $T_A^{s}=T_A^{n}$ so both types of consumers are fully insured.[1] Also from equation (42) both types of consumers' marginal utility of income equals the additional benefits they derive from an increase in treatment quality.

Using the fact that at a symmetric equilibrium $d_A=1/2$, equations (39) and (41) can be rewritten as (43) and (44), respectively.

$$H'(s+q_A^{s})[T_A-f\ q_A-(1-f\ )q_A^{n}]=t \qquad (43)$$

$$H'(q_A^{n})[T_A-f\ q_A-(1-f\ )q_A^{n}]=t \qquad (44)$$

Equation (42) implies that q_A^{s} and q_A^{n} both increase when T_A decreases. To see that the premia charged by the HMOs increase with consumers' risk of becoming severely sick, suppose instead that T_A does not increase, and q_A and q_A^{n} do not decrease when f increases. Then, the left hand sides of (43) and (44) decrease with f, while the right hand sides remain constant, thus violating the equations. So HMOs charge high-risk consumers higher premia than low-risk consumers. ■

Proof of Proposition 6. To see that T_A increases, and q_A^{s} and q_A^{n} decrease with t, suppose instead that T_A does not increase and q_A and q_A^{n} do not decrease when t increases. Then the left hand sides of equations (43) and (44) do not increase with t, a contradiction. Thus, T_A^* increases and q_A^n and q_A^m decrease with t. Since an increase in t affects HMOs' choices identically, it does not alter the number of the HMOs' enrollees as long as all consumers continue to contract with one of them. The changes in premia and treatment quality then result in higher HMO profits as t increases. ■

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[1] T_A is substituted for T_A^{s} and T_A^{n} in the rest of this appendix.

Proof of Proposition 7. Proposition 7 follows from Propositions 3 and 5 and from the data presented in Tables 1 and 2 ■

Proof of Proposition 8. Proposition 8 follows from the data presented in Tables 1 and 2 ■

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BIOGRAPHICAL SKETCH

My educational experiences have been truly international. I have attended schools in countries as diverse as Yugoslavia, India, Pakistan, and the United States. Because of these experiences, I became interested in international relations at an early age. I was, and continue to be, curious to examine the reasons that cause different countries to be different. Since differences in societies' economic systems are a key reason for differences among them, I started to read about economic issues and gradually became more and more interested in economics. I received my bachelor's degree in economics from Angelo State University in San Angelo, Texas, in May 1993. I hope to receive my Ph.D. in economics from the University of Florida in Gainesville, Florida, in August 1998.

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